1955
V. 12

Conseil Permanent International pour l' Exploration de la Mer

CHARLOTTENLUND SLOT — DANEMARK

ANNALES BIOLOGIQUES

VOLUME NO. XII

RÉDIGÉ PAR

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Scheme for the Arrangement of the Material

I. Review of Investigations and Essential Results

Each Committee Chairman should here give a summary of the contributions received, i. e., a statement of the nature of the material as well as a short review of the position in the area—including the main results obtained—during the last calendar year (unless otherwise stated). This review should only in exceptional cases exceed 2 pages (about 10,000 units of type). Papers should reach the General Secretary not later than 1. May.

II. Tables and Conclusions

A. Environment

1. Strength and direction of currents: Especially data collected during spawning seasons.

2 a. Temperature and salinity conditions: Tables and/or diagrams including anomalies.

2 b. Seasonal temperature variations at selected stations: Data including anomalies.

3. Phosphate concentration, oxygen, etc.: Tables and diagrams to include anomalies.

4. Plankton conditions: Tables and/or diagrams, especially anomalies in distribution of indicator forms, phytoplankton patches, amount of plankton and fat content.

5. Abundance of benthonic food: Data.

6. The main meteorological features of the year: Data especially as to sunlight, rainfall, and direction and force of the wind.

B. The Fish

For each species in the following order: Gadoids (cod, haddock, saithe, others), flatfishes (plaice, dab, flounder, sole, witch, lemon sole, halibut, others), herring, sprat, mackerel, other pelagic fishes, eel, redfish, others.

1. Abundance and distribution of eggs and larvae.
2. Abundance of year-classes: Data derived from experimental hauls.
3. Size- and age-composition of commercial catches or landings.
4. Average length of age-groups: Data from experimental hauls and commercial catches, with standard deviations.
5. Rate of growth: Data from marking experiments and quantitative experimental hauls.
6. Rate of mortality: Data from marking experiments and quantitative experimental hauls.
7. Intensity of fishing: Data as to the fisheries considered in 3, 4, and 8.
8. Quantities landed:—
   (a) Total catch (weight) of special fisheries.
   (b) Percentage of large, medium, and small.
   (c) Total number of the various species.
   (d) Size- and age-composition of commercial catches or landings.

C. Shellfish

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PREFACE

As has been repeatedly pointed out, the purpose of the *Annales Biologiques* is to give a general survey of the environments, the broods of the most important marine fishes, and the size and composition of their stocks during the year concerned. The Annales is a barometer of the characteristic situation in a given area in any particular year. The value of *Annales Biologiques* increases in importance when the *Bulletin Statistique* for the same, and sometimes for later, years is consulted, whereas the background researches are to be found in the Administrative Report for the corresponding year.

The contributions received by the Chairmen from the different authors form the basis of the Annales, and, as stressed in the "Scheme for the Arrangement of the Material" printed on the second cover page of each issue, the Chairmen should give a summary of the contributions received. This has, unfortunately, not always been possible.

Considering the general conditions in 1955 reference can be made to the Introductions to the sections of the Distant Northern Seas, Near Northern Seas, and the Baltic-Belt Seas Committees. It seems that the meteorological conditions have been rather exceptional, influencing the properties of the water masses to a considerable extent. In the Baltic the temperatures were considerably lower than the averages during the first six months of the year, owing to the cold winter, but increased as a whole to above the normal during the last six months of the year. Comparatively low temperatures in the period January to June were also observed in the German Bight and it seems that the hydrographical conditions in the North Sea, at least in its northern and central parts, were less oceanic than in 1954. Fortunately it was possible to collect comprehensive hydrographical data from the Barents Sea, and there seemed to be a trend towards somewhat lower temperatures in the arctic areas, a feature for which the unique weather conditions may be mainly responsible.

From the extensive material on Cod it seems that the 1955 year-class in Greenland waters will be poor and that no cod fry were carried to this area from Iceland. The following year-classes were predominant in important areas, from which information is available: —

Greenland (Offshore), 1947, 1950.
Iceland (Spawning Grounds), 1945, 1947, 1949.
Iceland (Feeding Grounds), 1949, 1950.
The Lofotens, 1947, 1948. Slight increase of the stock.
Finnmark, Norway, total catch far below estimates.

As regards Haddock the following year-classes were predominant: —

Iceland, 1950—1953. Increase in density.
Norwegian coast (arctic), 1948, 1950. Increase.
Barents Sea, 1950.
Faroe Islands, 1950—1953. Increase.
North Sea, 1951—1954.

At Iceland the predominant year-classes of Saithe were those of 1948 and 1949, but the density had decreased in recent years.

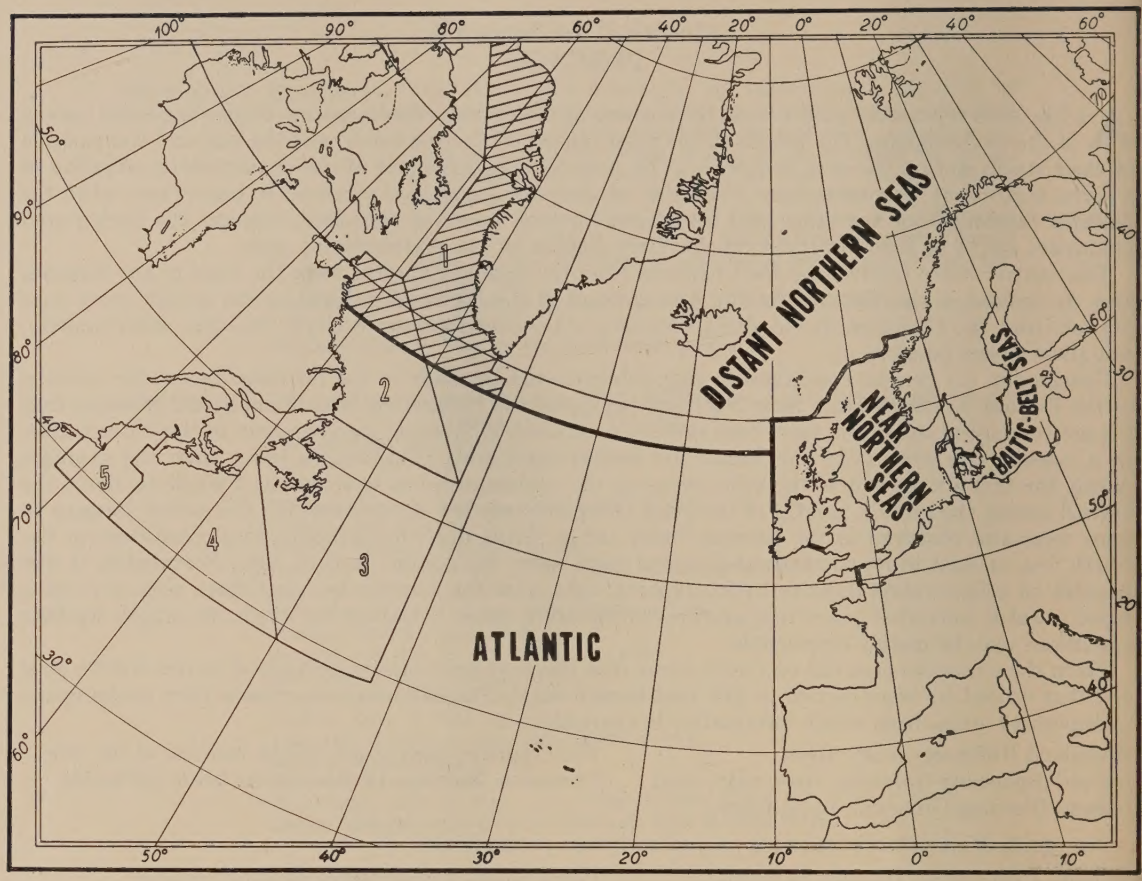
From the scanty information on Whiting it may be deduced that the broods of 1951, 1952, and 1954, especially the latter, predominated in the North Sea.

Turning now to the herring it is very satisfactory to state that an entirely new fishery has been developing north of the Faroe Islands in recent years, owing to the results of large-scale taggings and consequent annual Asdic and echo-survey of the area. The summer season of the north coast of Iceland in 1955 was a failure, whereas the winter season at Norway was very favourable. The catches in these two areas are based on several year-classes, but at Norway it appears that the 1950 brood will be exceptionally strong. As to the abundance of herring on the various fishing grounds and the strength of the different year-classes within the various stocks the reader may be referred to the report of the Herring Committee in which large numbers of valuable details are discussed.

It appears from this volume of the *Annales Biologiques* and from the corresponding Administrative Report in the *Rapports et Procès-Verbaux* that a very large number of fish of different species has been tagged and that the Asdic and echo-sounding methods are being applied to an increasing extent in order to localize shoals and to find new fishing grounds.

In conclusion, I should like to offer my best thanks to chairmen and contributors for their valuable co-operation, and a special thank should be conveyed to Mrs. H. Harder of the Central Office for her unremitting work in the preparation of this volume.

Árni Friðriksson



Map showing the areas covered by the new Area Committees of the I.C.E.S., and the area of Panel 1 of I.C.N.A.F. (hatched) which is also within the boundary of the Distant Northern Seas Committee.

The new boundaries of Area Committees are defined as follows:—

Distant Northern Seas Committee

The area of the North Atlantic north of the latitude of Rockall and thence north of the northern boundaries of the Near Northern Seas area.

Near Northern Seas Committee

On the south and east by the coastline of the European mainland and the 1946 Fisheries Convention boundary to the north of the Belts and the Sound. On the north from the Norwegian coast along latitude 64°N. until it reaches the 1000 m. contour thereafter along this contour to latitude 60°. On the west from latitude 60°N. southward along longitude 10°W. to the coast of Ireland, and along the north and east coasts of Ireland to Carnsore Point, thence in a straight line to Cape St. David along the English south and west coasts to longitude 2°W. and from this intersection along 2°W. to Cape La Hague.

Atlantic Committee

Between the latitudes of Rockall and the Equator and west of the western limits of the Near Northern Seas area and the European and African coast lines.

Baltic-Belts Seas Committee

The Baltic and Belt Seas south and east of the 1946 Fisheries Convention boundary, defined by lines drawn from Hasenore Head to Gniben Point, from Korshage to Spodsbjerg and from Gilbjerg Head to the Kullen.

Distant Northern Seas

INTRODUCTION

Contributions to this report have been received from:—

Denmark:
F. Hermann
J. Smed
England:
A. J. Lee
Germany:
C. H. Brandes
G. Dietrich
A. Kotthaus
W. Krauss
G. Krefft
Iceland:
J. Magnússon
A. Sigurðsson
U. Stefánsson
Scotland:
J. H. Fraser
A. D. McIntyre
J. H. Steele
B. B. Rae
E. Wilson

The reports from the different parts of the huge Distant Northern Seas area follow the lines of last year's report. It should, however, be noted that a very valuable contribution has been made this year from the north-eastern part of the area, viz., the Barents Sea. We are, however, without information on hydrological changes in the Atlantic Current from the Shetland area to Northern Norway.

Only few contributions are given on the fish stocks, other than Gadoid and Clupeoid fishes. It should, however, be stressed that valuable information is given on redfish, both from the Iceland-Greenland area and from the Faroe area.

Environment

As an outstanding event a comprehensive review is given on the hydrographic conditions in the Barents Sea in 1955. As it is the intention to follow up the results given in this report it should be possible to record, in the future, such changes as are likely to occur, and which may be expected to exert a great influence on the commercial fishery in northern waters.

The decrease in temperature and some alterations in the strength, width, and movement of the currents are striking features of the year in most parts of the Distant Northern Seas. As the year was rather unique in meteorological events it would, however, be premature to look upon the fluctuations as being of a permanent character, though some recorded changes during the last few years may be an indication of a diminution of the present warmer period.

The phyto- and zooplankton surveys are continued in the Faroe-Iceland area and some notes on sonic scattering in the subsurface layers should especially be noted.

The Fish

The plaice in Faxa Bay, the redfish in the central part of the Distant Northern Seas area and exotic fishes from the Faroe, Iceland, and Greenland waters constitute the main themes of this part of the report. Attention may be called to records on halibut eggs from the Denmark Strait in May as the records are contained in a hydrographic survey of the Denmark Strait, and as records of halibut eggs are rare, owing to the fact that they are bathypelagic or at any rate float considerably below the surface layers (see p. 40).

The plaice marking experiments from recent years show results which should be compared with those obtained earlier, e.g., before the war (see Rapp. et Proc.-Verb., **120**, 1948).

The reports on the redfish stocks in the Faroes, Iceland, and East Greenland waters give important information on the size composition of the stocks in various areas. But the reports also stress that we are badly in need of general knowledge of this, so very important, species, especially with regard to age assessment of the stocks, the taxonomy of the group, locality of spawning areas, dispersion of fry, and migration of adolescent, maturing and mature, and spent fish.

The report concludes with several records of rare or exotic fishes obtained in the area.

Å. Vedel Tåning

ENVIRONMENT

Hydrography

Monthly Anomalies of the Surface Temperature in Areas of the Northern North Atlantic in 1955

(Figures 1-4; Tables 1-2)

On the basis of data collected in 1955 by the Danish Meteorological Institute from Danish and Icelandic ships in the northern North Atlantic, anomalies of surface temperature have been evaluated for each month and each 1°-square, using RYDER's grand monthly means for the period 1876—1915 as standards. These anomalies were then averaged over the areas indicated in Figure 1.

The results are given in Table 1 where monthly anomalies are recorded together with the numbers of the observations on which they are based. In the last column of the table the monthly anomalies for each area have been averaged over the year.

Table 1 shows that positive anomalies still predominate. In fact, none of the yearly anomalies given in the last colum of Table 1 are negative. The distribution of the yearly anomalies over the whole region appears from Figure 2.

The average of the yearly anomalies given in the last column of Table 1 is 0.5°C., against 0.4°C.

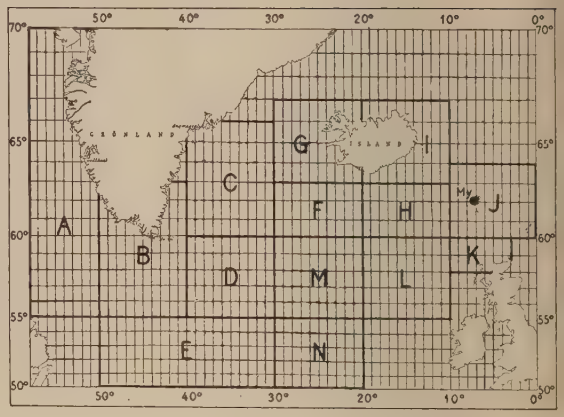


Figure 1. Location of areas A to N and of station My.

in 1954. The geographical distribution of the temperature variation from 1954 to 1955 is shown in Figure 3. There is, evidently, a tendency towards higher temperatures in the southern part of the region and towards lower temperatures in the northernmost part.

Table 2 gives grand monthly means of the surface temperature at Myggenæs, Faroes (station

Table 1. Monthly Anomalies (△°C.) and Numbers (n) of Observations of the Surface Temperature in the Areas A—N (see Figure 1) during 1955

	Jan.		Febr.		March		April		May		June		July		August		Sept.		Oct.		Nov.		Dec.		Aver.
	△	n	△	n	△	n	△	n	△	n	△	n	△	n	△	n	△	n	△	n	△	n	△	n	of △-val.
A ..	—	—	—	—	0.8	9	1.2	17	1.2	107	1.2	188	−0.4	223	−0.3	97	0.3	79	0.7	55	0.2	12	—	—	0.5
B ..	—	—	—	—	0.4	30	0.6	103	0.5	134	0.9	157	−0.4	160	−1.2	132	−0.9	104	−0.4	97	−0.2	85	0.3	4	0.0
C ..	—	—	—	—	0.5	9	0.9	26	0.8	63	1.3	55	0.4	86	−0.7	79	−0.4	46	0.0	47	0.5	4	—	—	0.4
D ..	1.2	17	−0.6	2	0.0	52	0.5	63	0.7	72	1.2	55	−0.1	49	−0.5	52	0.0	25	−0.1	55	1.1	−46	1.4	16	0.4
E ..	0.7	57	−0.1	33	1.8	44	0.8	33	1.1	69	0.4	73	0.0	50	0.1	77	−0.2	66	−0.1	59	0.7	87	1.1	100	0.5
F ..	−1.6	3	—	—	−0.1	30	0.7	90	0.4	97	0.8	85	0.2	111	−0.7	75	−0.7	55	0.2	50	0.7	35	0.5	28	0.0
G ..	1.2	12	2.1	13	0.8	17	1.1	3	0.7	10	1.4	17	0.0	17	−0.5	13	−0.2	18	0.1	12	0.6	14	0.2	10	0.6
H ..	0.7	51	0.3	54	0.3	63	0.5	128	0.4	121	1.0	111	0.7	162	0.5	127	0.4	101	0.3	81	0.7	73	0.3	59	0.5
I ..	1.0	9	0.4	7	0.5	9	0.1	6	1.0	9	1.6	33	1.1	22	1.2	14	0.9	18	1.1	7	0.6	8	1.3	8	0.9
J ..	0.4	43	0.5	46	0.2	72	0.7	67	0.2	70	0.5	106	1.1	109	1.3	91	1.2	64	0.5	63	0.9	61	0.5	50	0.7
K ..	0.3	58	−0.6	50	−0.3	51	0.3	63	0.1	61	0.8	66	1.1	70	1.5	72	0.9	64	0.2	62	1.1	47	0.7	50	0.5
L ..	0.4	47	0.1	23	−0.5	47	0.8	44	0.4	49	1.0	49	1.0	41	1.0	47	0.0	46	0.1	62	1.2	52	0.4	46	0.5
M ..	0.2	46	0.3	45	−0.3	52	0.8	38	0.8	44	1.0	28	0.3	40	0.1	56	0.2	48	−0.2	69	1.0	62	1.1	57	0.4
N ..	—	—	−0.5	10	0.8	2	1.1	7	0.9	12	0.7	26	1.4	3	1.3	28	−1.4	3	—	—	1.5	1	0.7	12	0.7

Table 2. Grand Monthly Means of the Surface Temperatures (°C.) at Myggenæs, Faroes (My in Figure 1), during the Period 1914—50 and Deviations for 1955 from these Means

	Jan.	Febr.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Year
Means 1914–50	6.3	6.0	5.9	6.3	7.1	8.2	9.3	9.8	9.7	9.1	7.9	7.0	7.7
Deviations 1955	–0.5	–0.8	–0.3	0.3	0.0	0.4	0.0	0.2	0.4	0.1	0.6	–0.3	0.0

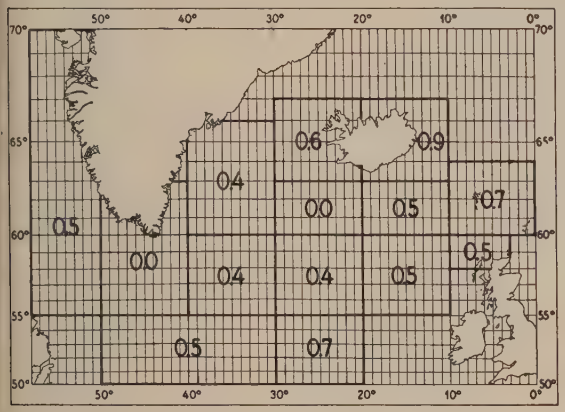


Figure 2. Yearly anomalies of surface temperature (°C.) for 1955.

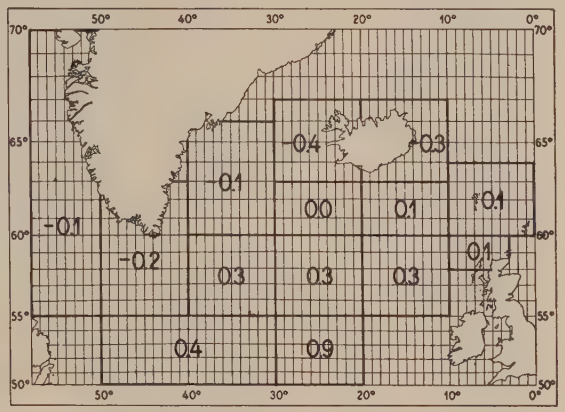


Figure 3. Variation of surface temperature (°C.) from 1954 to 1955.

My in Figure 1), during the period 1914—50, together with deviations for 1955 from these means based on data received from the Danish Meteorological Institute. The variation of the temperature at Myggenæs during the period 1914—55 is shown in Figure 4.

For placing data at my disposal I am greatly indebted to Messrs. I. Sestoft and H. Thomsen of the Danish Meteorological Institute.

Jens Smed

Figure 4. Yearly averages of the monthly anomalies of surface temperature at Myggenæs (Faroes), the period 1914—50 being taken as standard.

Figure 5. Mean surface temperatures in the northern North Atlantic in August.

New Monthly Mean Charts of the Northern North Atlantic Ocean

(Figures 5-6)

The charts of the mean surface temperature and salinity distribution in August are illustrated in Figures 5 and 6. The figures are reproduced from charts in a new edition of the "Wissenschaftliche Ergebnisse der Deutschen Atlantischen Expedition 'Meteor' 1925—1927", Vol. V, which will be published shortly.

The charts, prepared for each month, are based on computations of 400,000 temperature and 50,000 salinity observations in the period from 1868 to 1953. The material from the Barents Sea has been worked up on special charts from this region.

W. Krauss

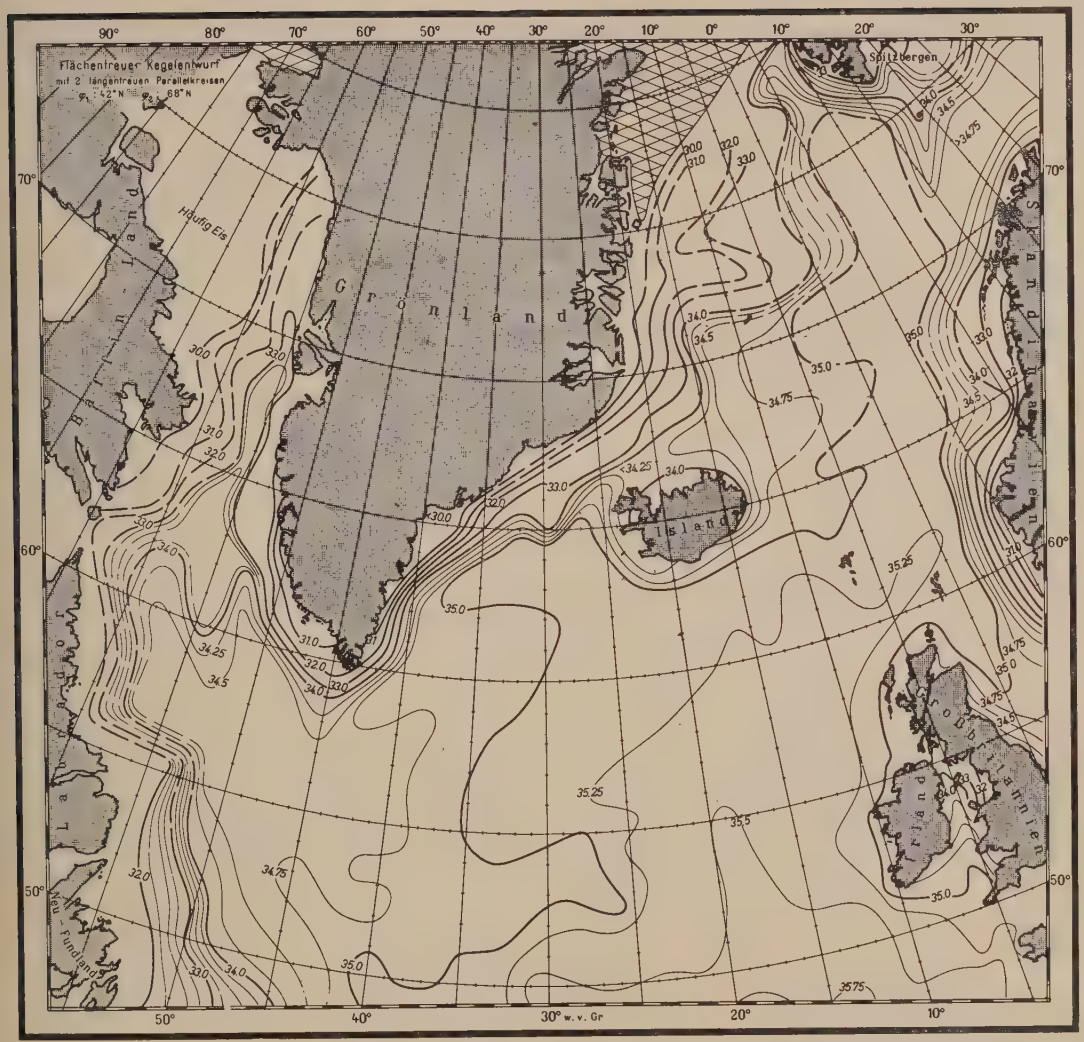


Figure 6. Mean surface salinity in the northern North Atlantic in August.

Hydrographic Conditions in the Barents Sea in 1955

(Figures 7-27)

During 1955 the English R/V "Ernest Holt" continued her investigations in the Barents Sea and made seven cruises in all. The first and the last of these were in the south-eastern Barents Sea, but on the others particular attention was paid to the distribution of cod along the western side of the Spitsbergen Shelf. On each cruise bottom temperature observations were taken and a thermograph was run continuously at a depth of 4.5 m. The West Bear Island Section running along the 74° 25'N. parallel westwards from Bear Island to the 13° E. meridian was scheduled to be worked in April and November, but in the event it was not made in the latter month owing to severe weather conditions. Nevertheless, the section between Fugløy and Bear Island was worked in late November and the section running towards Goose Bank from Vardø in early December. The positions of all the sections are shown in Figure 7.

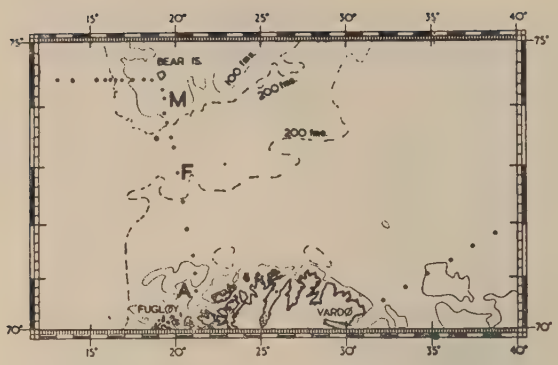


Figure 7. Positions of sections worked by R/V "Ernest Holt" in 1955.

Surface temperature

The temperature distributions at 4.5 m. for the seven cruises are shown in Figures 8—14. Figure 8 shows conditions in the entrance to the White Sea at the end of January. The surface temperature of the Murman Current was between 3° and 5°C. and tongue of colder water was pushing north-westwards from the White Sea entrance across the bank between the North and South Deeps.

By March surface water above 5°C. was absent from the Barents Sea east of about longitude 21°E. This is shown by Figure 9. Surface temperatures between 4° and 5°C. extended from the Norwegian coast to the Bear Island Bank where a sharp and complicated front, which more or less coincided with the 100 fathom isobath, marked the boundary between the Atlantic and Arctic waters. To the east and south of Bear Island the surface temperature was below –1°C., but no ice was observed.

Similar conditions prevailed at the end of April and beginning of May and are shown in Figure 10. The surface temperature of the Atlantic water of the North Cape and West Spitsbergen Currents had decreased slightly since March. The front between the Atlantic and Arctic waters remained complex and the trend of the isotherms to the south-west of Bear Island shows that the Bear Island Current was tending to swing in an anticlockwise direction after passing Bear Island. Packice was observed at several points and the distributions of ice and surface temperature to west of Bear Island were changing rapidly with the wind conditions at this time, but Figure 10 can be regarded as a synoptic picture, if no attention is paid to the minor details.

Figure 11 shows that by early June surface temperatures in the Bear Island area had increased. Nevertheless surface water below 1°C. was to be found stretching along the whole of the western edge of the Spitsbergen Shelf from Bear Island to Sørkapp Bank. Packice was observed in the southern part of the entrance to the Storfjordrenna and surface water below –1°C. was found stretching southwards from Sørkapp. The Arcto-Atlantic water boundary was again complex and was over the bank near Bear Island, but well out over deep water west of Spitsbergen. The surface

Figure 8. Surface temperature of the south-eastern Barents Sea: 19. January—1. February 1955.

Figure 9. Surface temperature of the south-western Barents Sea: 2.—16. March 1955.

temperature of the West Spitsbergen Current was above 5°C. to as far north as latitude 75°N.

By the latter half of July conditions had changed greatly. Surface temperatures below 1°C. were confined to a narrow tongue to the south of Hope Island, as shown by Figure 12, and Bear Island was surrounded by water above 3°C. The Bear Island Current was a narrow ribbon to the south-east of the Bear Island — Hope Island axis. As a result the front between the Atlantic and Arctic waters was now less steep and not so complex. In the West Spitsbergen Current surface water above 5°C. was found as far north as Prince Charles Forland and water above 6°C. up to latitude 77°N. Offshoots of this current took warm surface water over the Bear Island Bank mainly by the routes afforded by the Storfjordrenna and the North West Gully. In the Bear Island Channel surface temperatures were above 6°C. These increased southwards to about 8°C. off the Norwegian coast.

Figure 13 shows conditions in September in which month temperatures are usually at a maximum. The 6°C. isotherm now reached past latitude 79°N. and temperatures between 10° and 6°C. were observed between Norway and Bear Island. The advance of warm water on to the bank along the North West Gully and the Storfjordrenna can again be observed.

By the end of November surface water below —1°C. had again reached Bear Island and most of the area between Bear Island and Norway had a temperature below 6°C. Figure 14 shows that the surface temperature of the North Cape Current ranged from over 7°C. off Fugløy to about 5°C. off Vardø.

Since 1950 a thermograph has been used almost continually aboard the "Ernest Holt" and the ship has crossed or passed near certain fixed points on several cruises, thus allowing the annual cycle of surface temperature in each year to be observed. Three such points are shown in Figure 7. Station A (70° 46′N., 21° 14′E.) is situated in Norwegian coastal water: Station F (72° 54′N., 20° 01′E.) is in the Atlantic water entering the Bear Island Channel: Station M (74° 08′N., 19° 14′E.) is on the Bear Island Bank and is sometimes in Arctic water and sometimes in mixed Arctic and Atlantic water. The annual cycles of surface

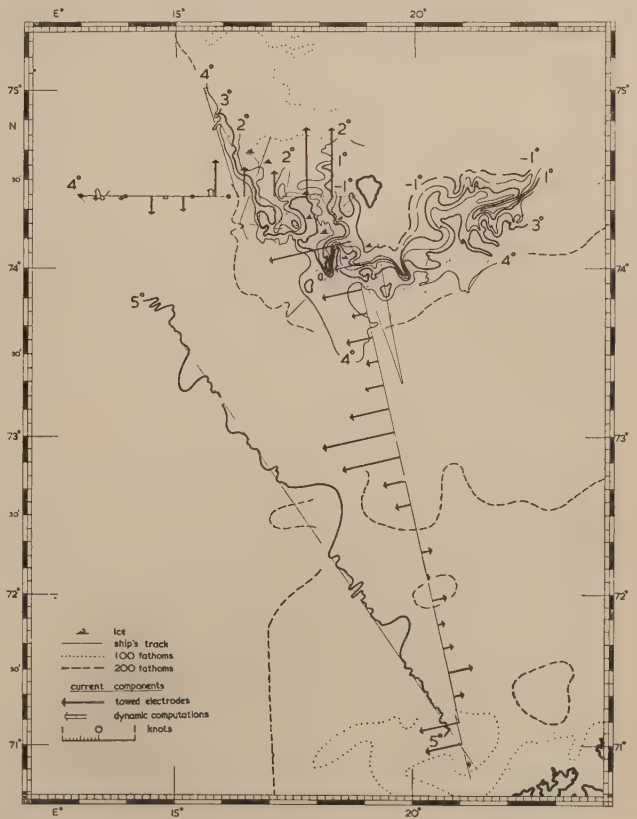


Figure 10. Surface temperature of the south-western Barents Sea and current components obtained with towed electrodes: 21. April—1. May 1955.

Figure 11. Surface temperature of the Bear Island—Spitsbergen area: 31. May—11. June 1955.

temperature for these three stations for the years 1950—51 and 1953—5 are given in Figures 15—17. No observations are available for the summer of 1952 so this year has to be omitted. The lines joining the observation points are intended as a guide to the eye and not to indicate the actual courses of the temperature cycles. Very long gaps have been closed by dashed lines.

Figure 15 shows that at Station A the surface temperature maximum is in August—September and the minimum in late April. The rise from the minimum to the maximum can be very sharp, as in 1953. 1955 appears to have been the coldest year of the five examined and 1950 the warmest. Figure 16 indicates that similar conditions have prevailed at Station F but that the annual temperature range is much smaller. The regime at Station M is more complicated as this station is near the front between the Atlantic and Arctic waters. Movements of this front cause sudden changes in temperature. The one that occurred in October 1950 is a marked feature in Figure 17. 1954 is seen to have been an outstandingly warm year on the Bear Island Bank. 1950 is not so noticeably warm as at Stations A and F, but 1955 is again the coldest year.

Bottom temperature

Figures 18—23 show the temperature distributions on the sea bottom on each of the first six cruises. The last cruise is omitted as only a small number of observations was made. The bottom temperature distribution in the entrance to the White Sea in January is given in Figure 18. No similar chart for a different year is available for comparison.

Conditions in March in the Bear Island area are shown in Figure 19. Water below —1°C. was found to the south of Bear Island and a band of water above 3°C. lay along the western edge of the bank. An outstanding feature is the entry of water above 3°C. into the deep part of the Bear Island Channel. The eastward limit of the 3°C. isotherm was not ascertained, but bottom water above 2°C. reached to at least 85 miles east of Bear Island. This feature had been found throughout the whole of 1954, when a tongue of water above 2°C. advanced along the eastern edge of the Bear Island Bank and reached latitude 77°N. By December 1954 a tongue of bottom water above 3°C. reached past the South East Gullies and had its axis along the 100 fathom isobath. As can be seen from Figure 19, this tongue had

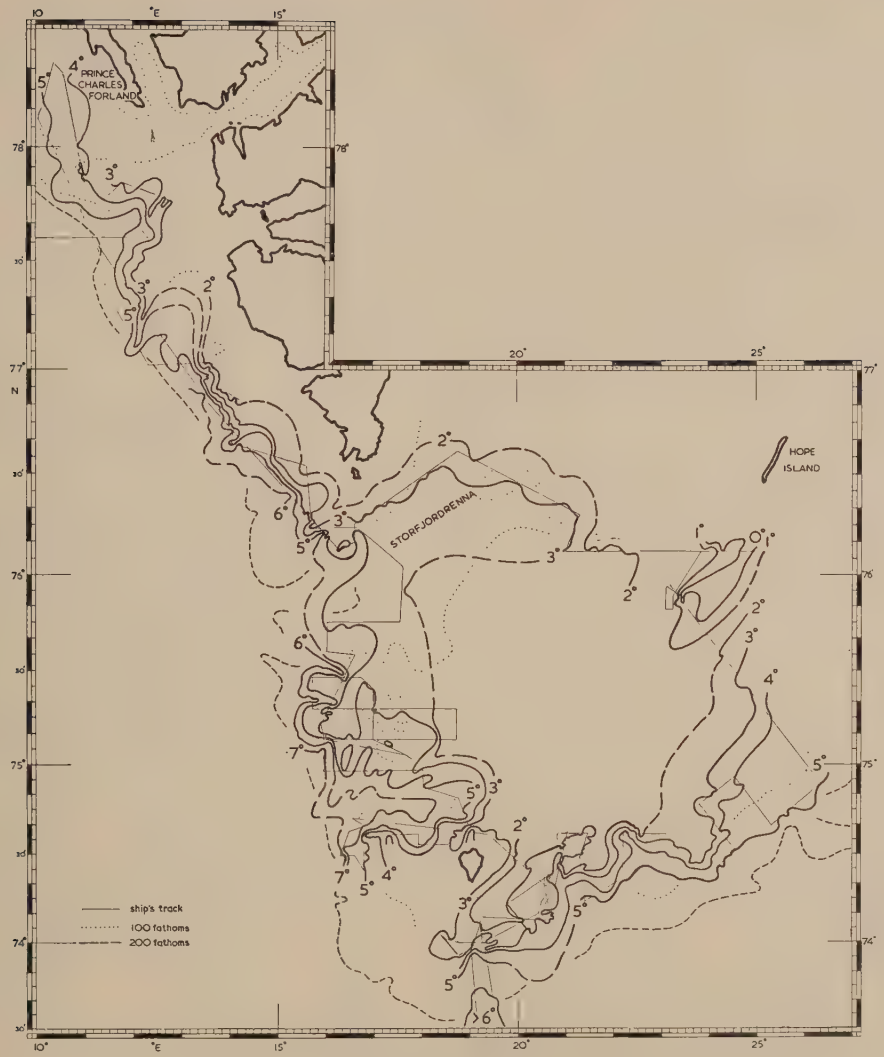


Figure 12. Surface temperature of the Bear Island—Spitsbergen area: 15.—30. July 1955.

been displaced into depths greater than 200 fathoms by March 1955. The tongue of bottom water above 2°C. in the South East Gullies is another prominent feature of Figure 19. A similar but more pronounced tongue was found at the corresponding time in 1954.

By the end of April colder water covered nearly the whole area. Figure 20 shows that no bottom water above 3°C. was observed, even on the western edge of the bank where bottom water above 4°C. is normally present. To the south of Bear Island water just below 3°C. was found at the bottom of the Bear Island Channel, but on the bank itself bottom water above 2°C. was confined to a small tongue in about 100 fathoms depth. The warm tongue in the South East Gullies had been pinched out. It will be shown later that the low temperatures prevailing over the whole of the bank at this time were due to winter cooling and cascading of cooled water from the shallower parts of the banks to the deeps.

The start of the increase of bottom temperatures from the April—May minimum is shown by the temperature distribution for early June given in Figure 21. Although most of the Spitsbergen Shelf to at least as far north as Hornsund was still

Figure 13. Surface temperature of the Bear Island—Spitsbergen area: 6.—21. September 1955.

Figure 13

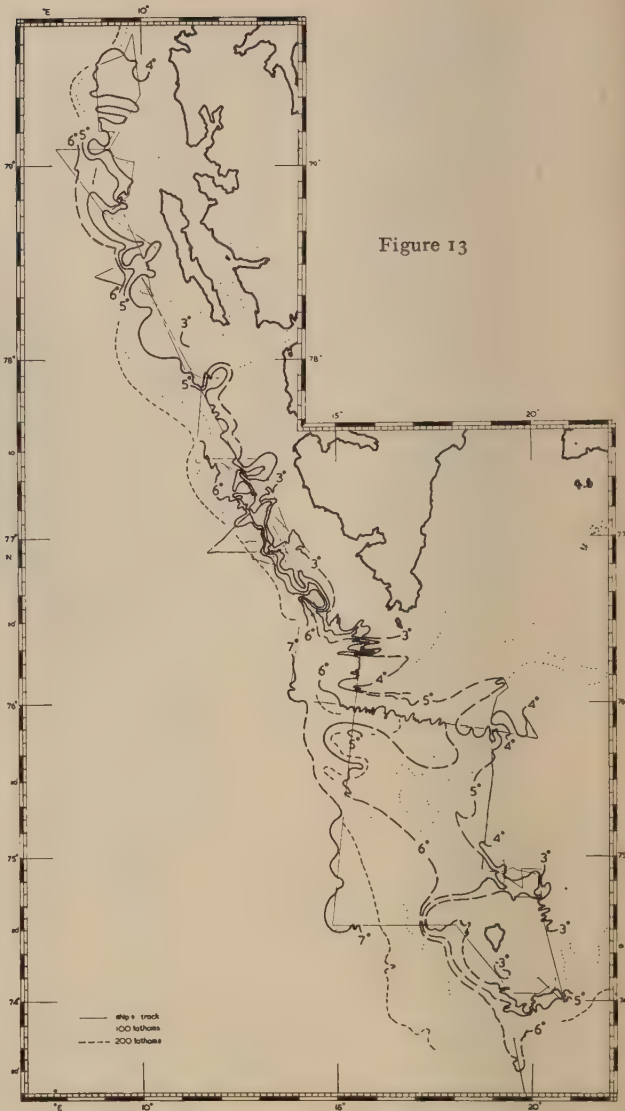


Figure 14. Surface temperature of the southern Barents Sea: 24. November—8. December 1955.

Figure 14

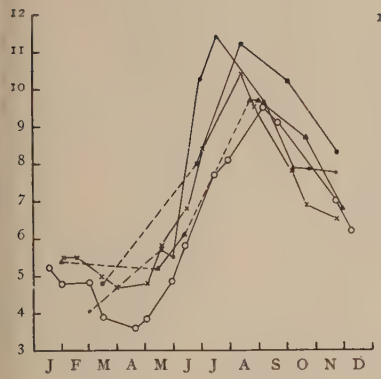


Figure 15. Surface temperature at Station A (70° 46′ N.: 21° 14′ E.): 1950—5.

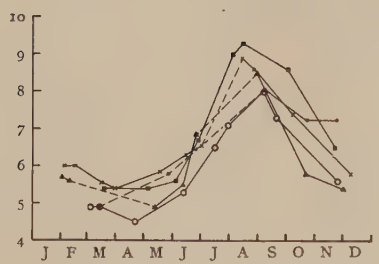


Figure 16. Surface temperature at Station F (72° 54′ N.: 20° 01′ E.): 1950—5.

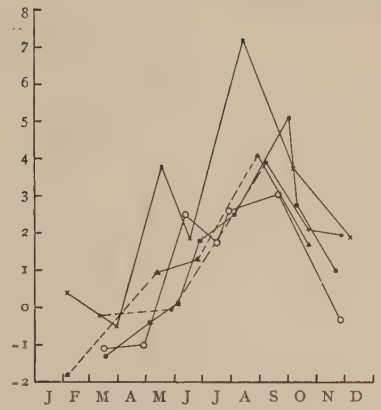


Figure 17. Surface temperature at Station M (74° 08′ N.: 19° 14′ E.): 1950—5.

○ 1955
× 1954
● 1953
▲ 1951
■ 1950

Figure 18. Bottom temperature distribution in the south-eastern Barents Sea: 20.— 30. January 1955.

Figure 20. Bottom temperature distribution in the Bear Island area: 21. April—1. May 1955.

Figure 19. Bottom temperature distribution in the Bear Island area: 3.—14. March 1955.

Figure 19.

Figure 21. Bottom temperature distribution in the Bear Island–Spitsbergen area: 31. May—11. June 1955.

covered by bottom water below 2°C., water above 3°C. had again appeared along its western edge, and water above 2°C. was still present along its eastern and southern flanks. Further improvement is shown in Figure 22, the chart for the end of July. Bottom water above 4°C. was then found along the western edge of the shelf to as far north as latitude 77°N., and bottom temperatures above 2°C. were not only found along the eastern edge, but also over the shallowest part of the bank. Warm water appears to have been moving on to the bank along the North West Gully. The Bear Island Current was giving rise to the cold tongue close to the south-east of the Bear Island — Hope Island axis, whilst the very cold water at the bottom of the Storfjordrenna was the product of winter cooling. From Figure 23 it can be seen that this latter water was still present in September, when a further increase of bottom temperature had occurred on all the banks, water above 4°C. being found as far north as the Forlands Bank and on the bank to the north-east of Bear Island.

Sections

The West Bear Island Section was worked on 22. April and the temperature and salinity distributions are shown in Figure 24. They portray conditions in the West Spitsbergen Current in hydrographic midwinter. No complete section taken at the same time in a different year is available for purposes of comparison, but Station S, which is usually in the core of the West Spitsbergen Current, was made during the first half of May in 1951 and 1954. Temperatures at this station in 1955 were similar to those in 1951, but were nearly 1°C. lower than those in 1954 over mose of the water column. There were no great differences between the salinity profiles for the three years.

Figure 24 shows water above 3°C. on the bottom between Stations P and R, but no such water appears in Figure 10. Similarly the surface temperature distribution shown in Figure 24 does not agree with that given in Figure 20. These differences are due to the fact that the section was worked when the "Ernest Holt" first reached Bear Island on 22. April and that almost immediately afterwards a prolonged north-easterly gale occurred and changed the distributions. The changes on the bottom can be explained in terms of cascading of cold dense water from the shallow parts of the banks down the slopes. By 22. April the water on the bottom at Station P was already denser than that on the bottom further down the continental slope at Stations Q and R and was poised

Figure 22. Bottom temperature distribution in the Bear Island–Spitsbergen area: 15.—29. July 1955.

to move down the slope. The north-easterly gale that followed triggered-off the cascading movement.

The volume transport across the section between Stations S and W and above 400 metres depth has been calculated using the 750 dbar surface as the reference level. It was found to be 1.2 km.³/hour southwards. Stations S and W were made again on 1. May and on this occasion the volume transport amounted to 1.8 km.³/hour northwards. In mid-May 1954 the volume transport was much greater and amounted to 8.4 km.³/hour northwards; in early May 1951 it was 0.2 km.³/hour southwards.

During this cruise towed electrodes were used on a line between Norway and Bear Island on 20. — 21. April and on the West Bear Island Section on 22. April. The average component of the current at right angles to each of these two lines for each hour of the ship's run has been calculated from the towed electrode records and has been plotted in Figure 10. The easterly flow of the North Cape Current can be seen, together with a westerly flow of the surface water in the Bear Island Channel and over the Bear Island Bank. On the West Bear Island Section there is a northerly flow on

Figure 23. Bottom temperature distribution in the Bear Island–Spitsbergen area: 6.—21. September 1955.

the bank, but a southerly flow over the deep water west of Station U. The average surface velocities between each pair of stations in deep water have also been calculated by using the 750 dbar surface as the reference level. The results are superimposed on the towed electrode results in Figure 10 and the two sets of results are seen to be in agreement as regards direction but not speed.

The Fugløy — Bear Island Section was worked on 25.—26. November and the temperature distribution is shown in Figure 25. No salinity data are available as it was found that some of the samples gave impossibly low salinities when titrated. The samples became frozen during the severe weather experienced on this cruise, and the subsequent expansion forced the bottle stoppers and let concentrated brine escape. with the result that low salinities were obtained when the samples were titrated. The temperature and salinity distributions on the section made from Vardø towards Goose Bank on 1.—2. December are shown in Figure 26. No data are available for comparison with other years for either of these sections. Figures 25 and 26 show that the width of the warm Atlantic stream entering the Barents

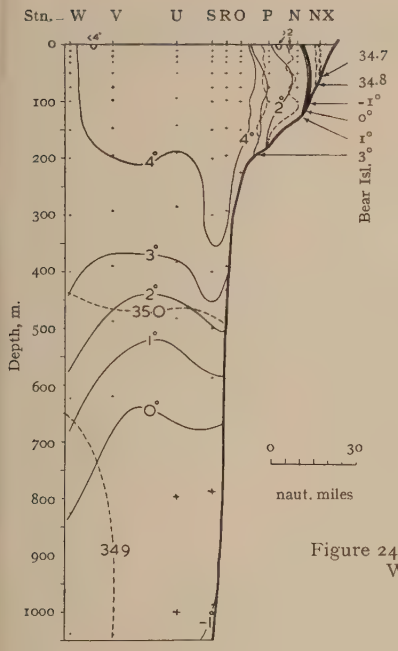


Figure 24

Figure 25. Distribution of temperature and dissolved oxygen (ml./l.) on the Fugløy–Bear Island Section: 25.—26. November 1955.

Figure 24. Distribution of temperature and salinity on the West Bear Island Section: 22. April 1955.

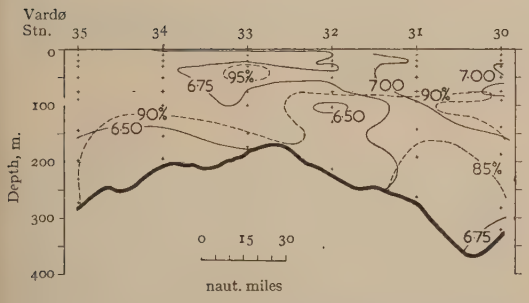


Figure 27. Distribution of dissolved oxygen expressed as ml./l. and percentage saturation on the Vardø– Goose Bank Section: 1.—2. December 1955.

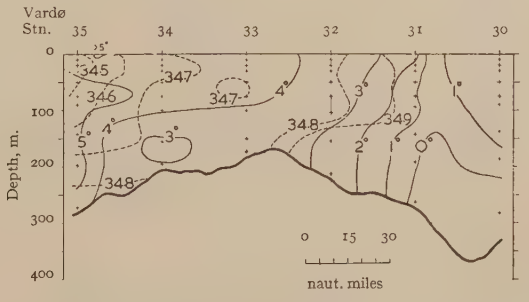


Figure 26. Distribution of temperature and salinity on the Vardø–Goose Bank Section: 1.—2. December 1955.

Sea is rapidly reduced. Temperatures above 5°C. were found to about 160 miles north of the Norwegian coast along the Fugløy — Bear Island Section, but only up to about 50 miles north of Vardø. No water above 35‰ salinity was found on the Vardø — Goose Bank Section, whereas the salinity values obtained for the Fugløy — Bear Island Section are good enough to show that there water above 35‰ salinity reached at least as far north as the 5°C. isotherm.

The distributions of dissolved oxygen on the the two sections are given in Figures 25 and 27. The percentage saturation values for the Fugløy — Bear Island Section are not given as they cannot be obtained precisely owing to the lack of salinity values, but they are the same magnitude as those on the more easterly section. The cessation of photosynthesis and the onset of increased vertical circulation due to winter cooling are seen to have led to a reduction of dissolved oxygen in the surface layers, but the vertical mixing had not been great enough by early December to have increased the oxygen content of the deeper layers.

A. J. Lee

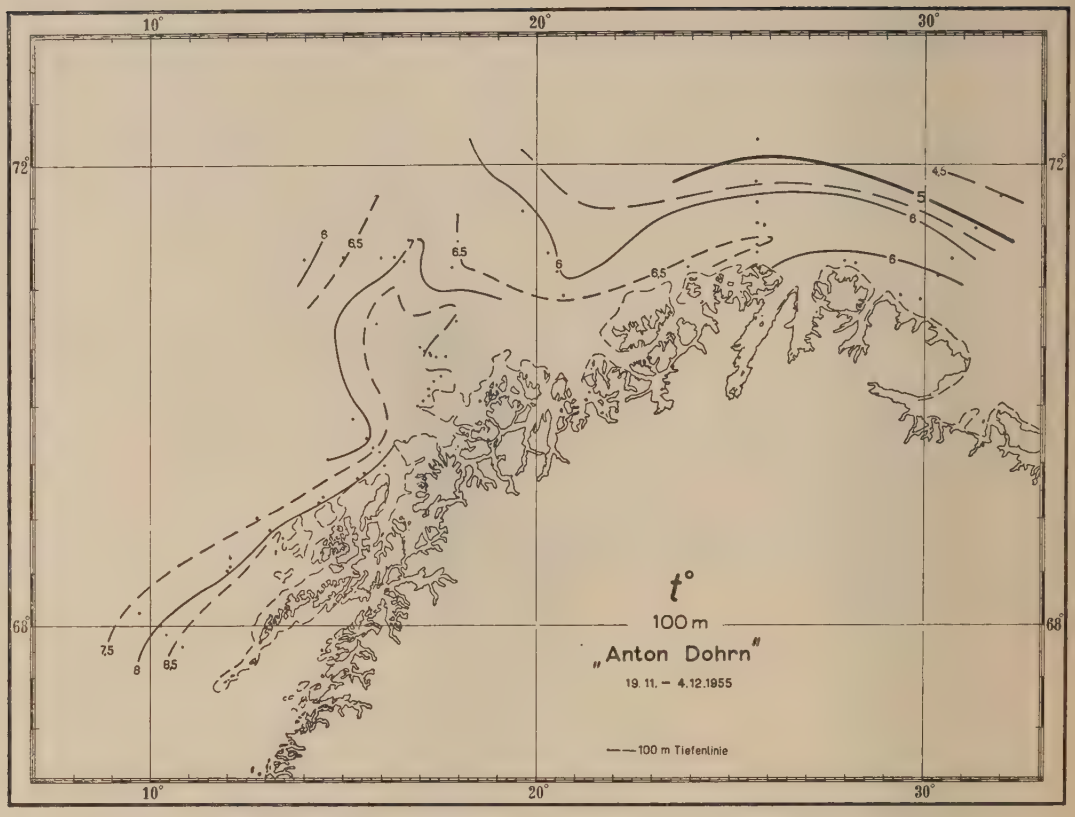


Figure 28. Temperature distribution at 100 m. depth.

Hydrographic Conditions in the North-West and Northern Norwegian Waters in November—December 1955

(Figures 28-31)

The research vessel "Anton Dohrn" worked 64 hydrographic stations in the region between Røst and Makkaur from 19. November to 4. December 1955. Figures 28 and 29 show the temperature and salinity distribution at 100 m. depth.

The salinity differences were very high in the coastal waters, but the differences in temperature in inshore and offshore waters were slight only. A part of the highly saline water of the Norwegian Current passes round north Norway, but the main part of this water mass advances towards Spitsbergen. The temperature distribution is influenced by the vertical convection, which according to the stratification has advanced regionally into different depths.

Figure 30 shows a section across the Norwegian Shelf. The temperature and salinity distributions are given together with the velocity distribution; the salinity differences are great, producing the current in this region.

Figure 31 shows a section of the whole Norwegian Current. The relatively saline and warm Atlantic water mixes continually with the subarctic bottom water and with the coastal water on the shelf.

If the 1200 m. level is selected as reference level for current computation the surface velocities are considerable. The maximum current is found on the edge of the shelf.

W. Krauss

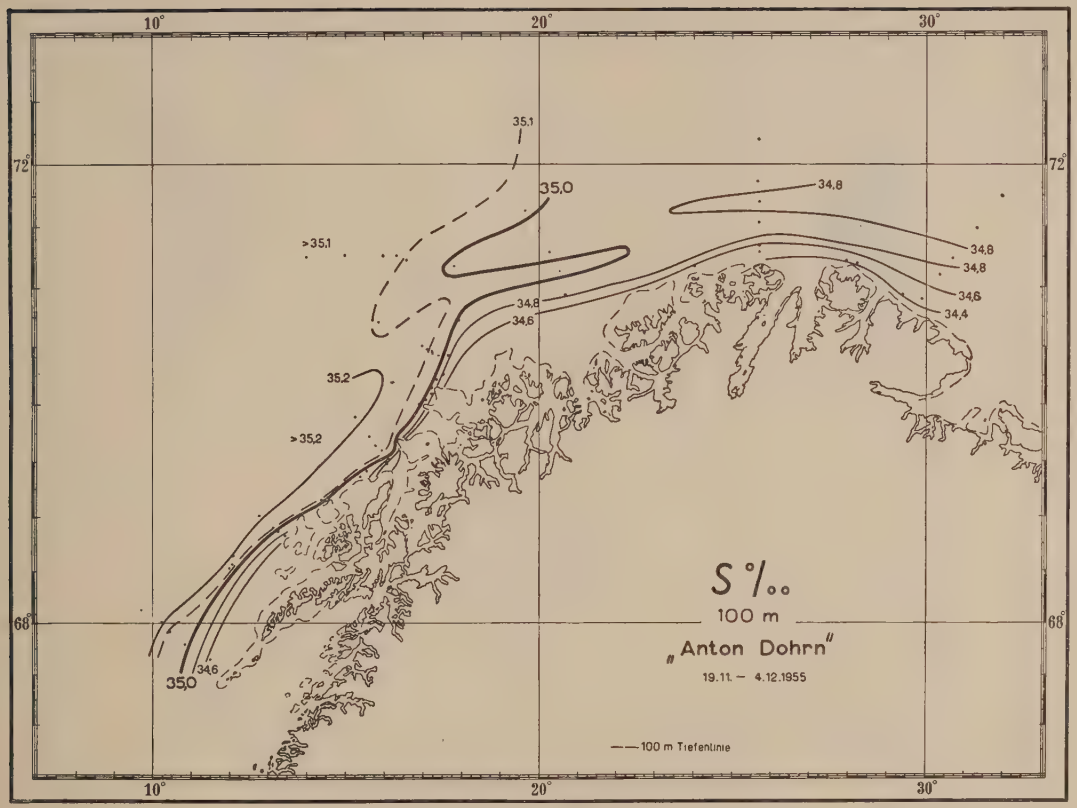


Figure 29. Salinity distribution at 100 m. depth

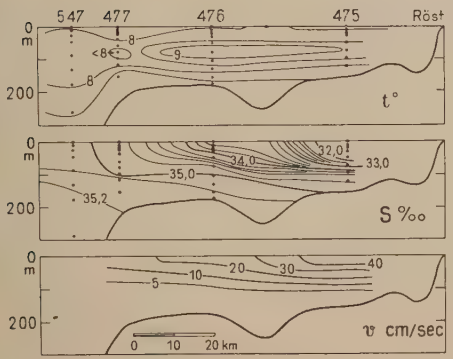


Figure 30. Temperature, salinity, and velocity distribution in the Norwegian coastal waters (Røst section).

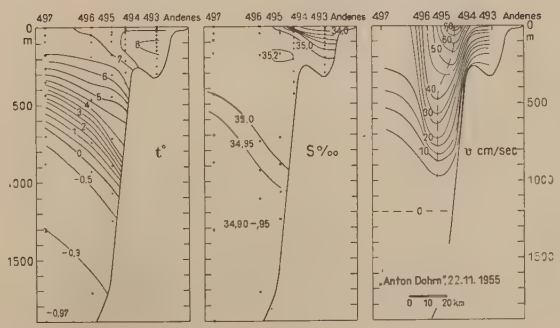


Figure 31. Temperature, salinity, and velocity distribution in a section across the Norwegian Current (off Andenes).

Figure 32. Distribution of temperature and salinity at 20 m. depth, June 1955.

Hydrographic Conditions in the Southern Part of the Norwegian Sea, June 1955

(Figures 32-35)

The Faroe-Shetland Channel and the area north of the Faroes to 67°N. were investigated in June by the R/V "Dana" under the leadership of Dr. E. Bertelsen. Figures 32 and 33 show the temperature and salinity distribution at 20 m. and 100 m. respectively. Conditions are further illustrated by the Faroe- Shetland section (Fig. 34) and a section from the Faroes to 62°40′N., 5°30′W. and then towards north along 5°30′W. (Fig. 35).

The boundary between the warm Atlantic water and the water masses of the East Icelandic Current was sharply defined, as in previous years, especially at the 100 m. level. Many of the features of the boundary are found every year and must be due to the configuration of the bottom. The main difference from the previous years is that the tongue of cold water extended further south-westwards towards the Faroes than usual. It is remarkable that the greatest concentration of herring recorded was found over this cold tongue.

The temperature of the water in most of the area was from $^1/_2$° to 1°C. lower than in June 1954.

F. Hermann

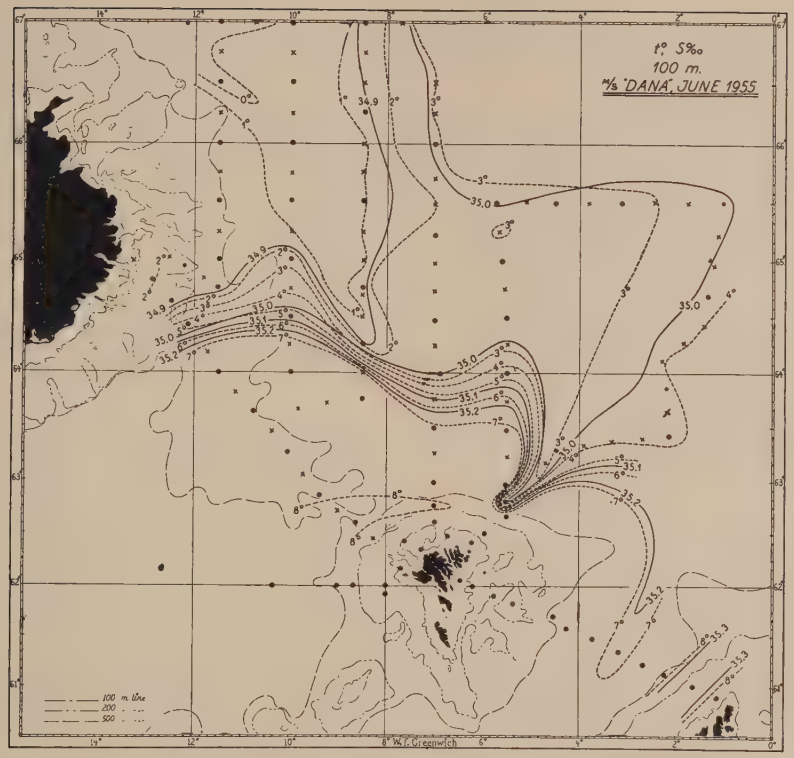


Figure 33. Distribution of temperature and salinity at 100 m. depth, June 1955.

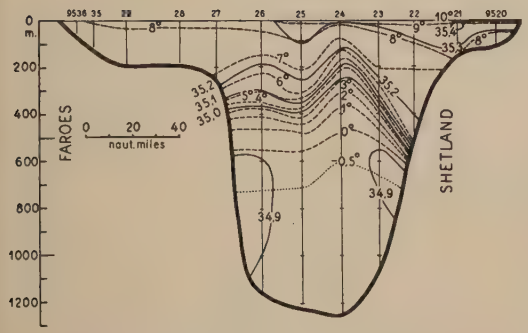


Figure 34. Faroe-Shetland section, 4. to 5. June 1955.

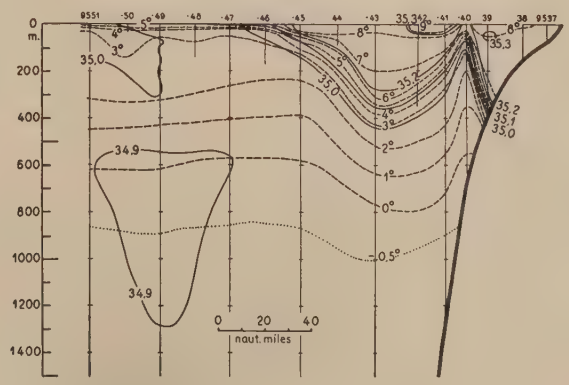


Figure 35. Section along 5° 30′ W., 6. to 8. June 1955.

Hydrographic Conditions North and North-East of Iceland 1955

(Figures 36-46)

In connexion with the herring investigations made by M/S "Ægir" under the leadership of Dr. H. Einarsson during the summer months of 1955 hydrographic observations were made in the waters north and north-east of Iceland. Besides, several fixed stations in the north Icelandic coastal area were worked during winter and spring.

In the region north of Siglufjörður the winter lasted about one month longer in 1955 than in the preceding year and the Atlantic water was first observed in late May in this part of the coastal area (Fig. 36). It seems likely that easterly winds which were much more persistent during the spring of 1955 than during that of 1954 account for the later influx.

The ice limit was about 100 miles offshore in early June, thus being much farther off than normally observed for that time of the year. The north-western area was icefree as far as 68°N. throughout the summer.

North of Kögur (Fig. 37) the distribution of Atlantic water was exceptional in June, and the influx appears to have been quite strong. Atlantic water with temperatures about 6°C. or above,

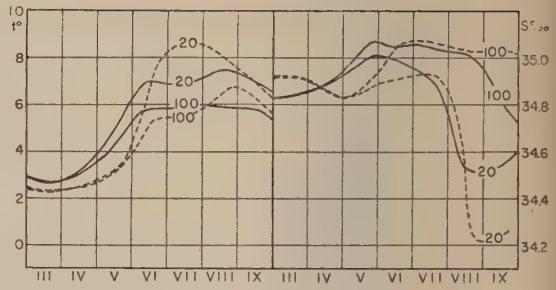


Figure 36. Variations in temperature and salinity at 20 and 100 metres depth off Siglufjörður at 66°32′ N., 18° 50′ W., from March to September. Solid lines 1954, hatched lines 1955.

extended at this time from surface to bottom some 50 miles offshore. In June 1954 the Atlantic influence was decidedly less pronounced. Over the slope the east-going current was evidently strong, but in the mixing area farther north some Atlantic water was carried back to the south-west as indicated by the temperature and salinity at St. 99. Dynamical calculations indicated that the surface current was much stronger and the transport to the south-west greater than in June 1954 in the northernmost part of the section which extends half-way across the Iceland-Greenland Channel.

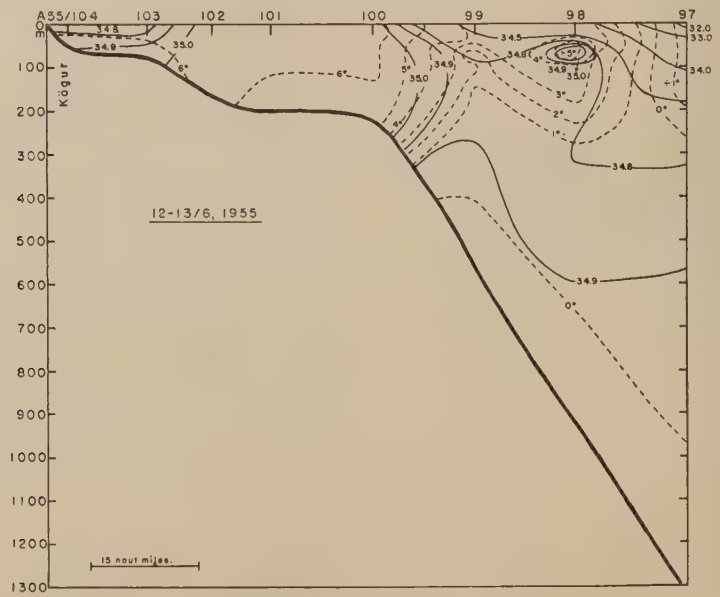


Figure 37. Distribution of temperature and salinity in a section N.N.W. of Kögur in June 1955.

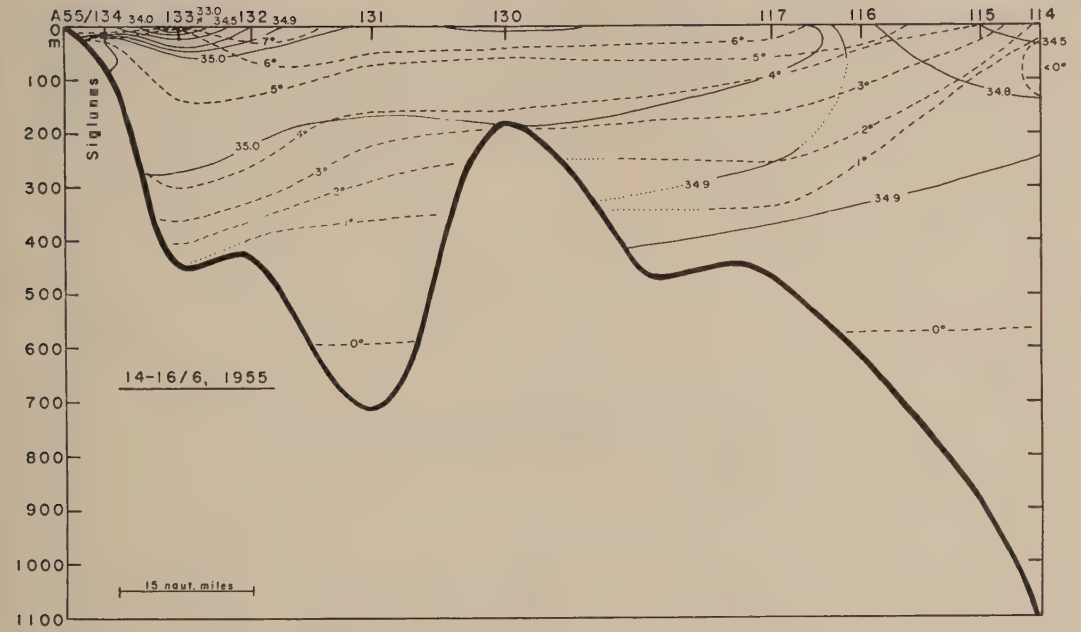


Figure 38. Distribution of temperature and salinity in a section north of Siglufjörður in June 1955. (Fig. 39, see next page).

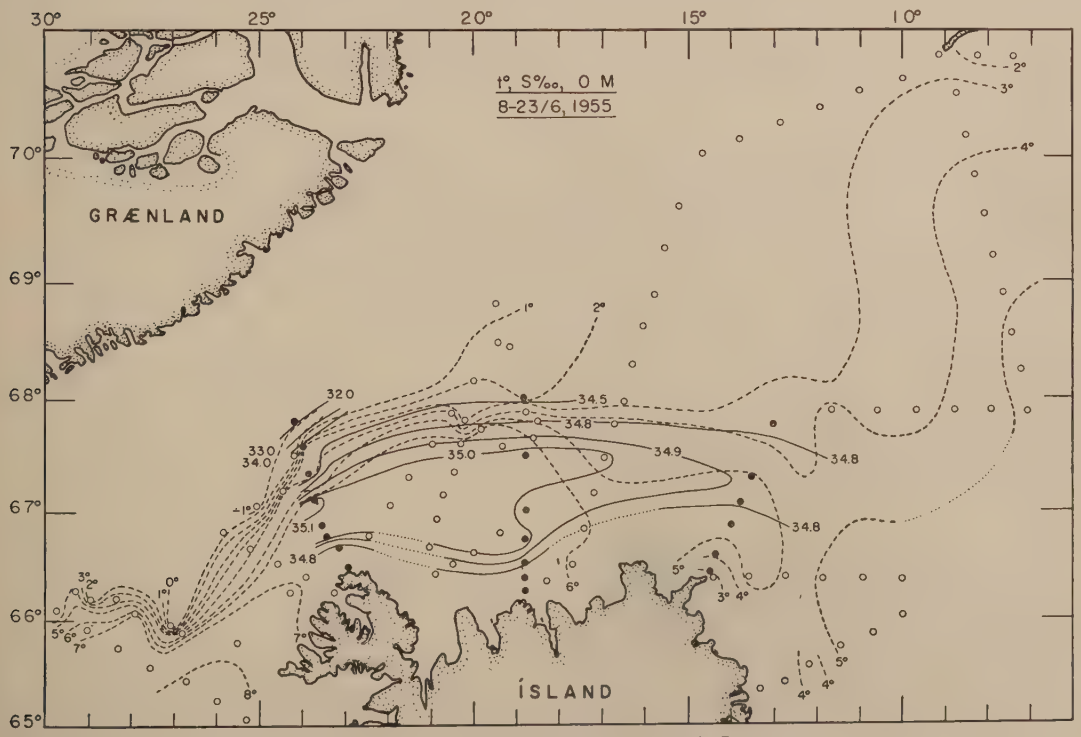


Figure 40. Temperature and salinity at surface in June 1955.
The circles denote BT stations, the black dots hydrographical stations.

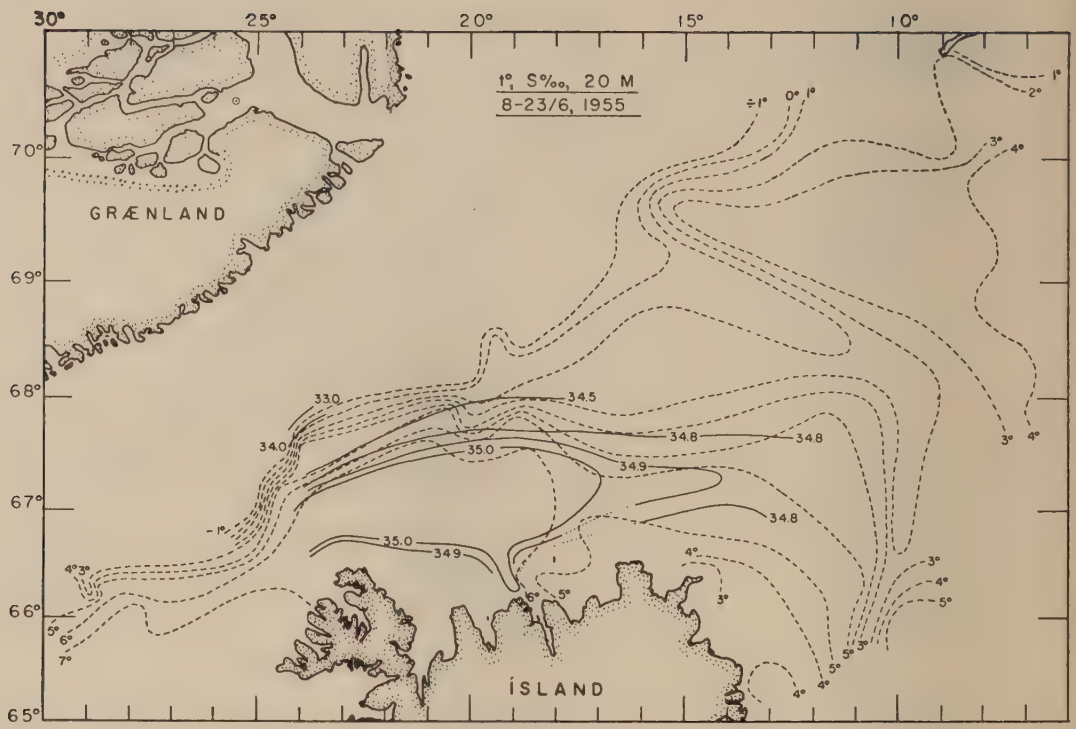


Figure 41. Temperature and salinity at 20 m. in June 1955.

In the region north of Siglufjörður (Fig. 38) the hydrographic situation in June, especially at subsurface depths resembled closely that of 1954. Farther north, however, near 68°N., almost undiluted polar water was observed, whereas in 1954 the warmer water extended farther north.

North-east of Langanes the sea temperature was decidedly lower than in June 1954 and Atlantic influence less pronounced, although a tongue of relatively saline water appeared at St. 174 (Fig. 39). In general the sea temperature was more uniform in the north Icelandic coastal area in June 1954 than in June 1955, and this difference can no doubt be ascribed to a much later Atlantic influx in 1955.

The hydrographic conditions in the Icelandic coastal area are further illustrated by Figures 40—43 showing the horizontal distribution of temperature and salinity at various depths. Apparently the Atlantic water had extended east to Langanes in 1955, but in June 1954 the Atlantic influence could be traced farther east and south. In the oceanic area between Langanes and Jan Mayen the temperature of the surface layers was lower

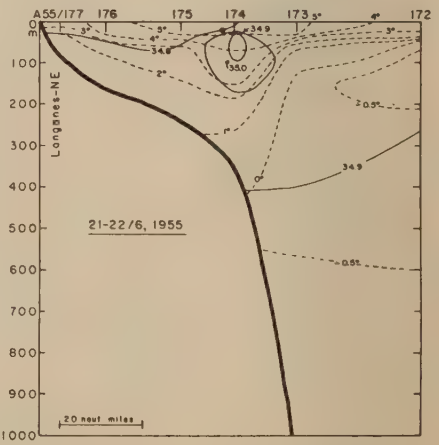


Figure 39. Distribution of temperature and salinity in a section N.E. of Langanes in June 1955.

in 1955 than in most of the preceding years and the tongue of cold water more apparent. However, north and east of the cold tongue the temperature of the surface layers was somewhat higher. Below the thermocline the tongue of cold water was

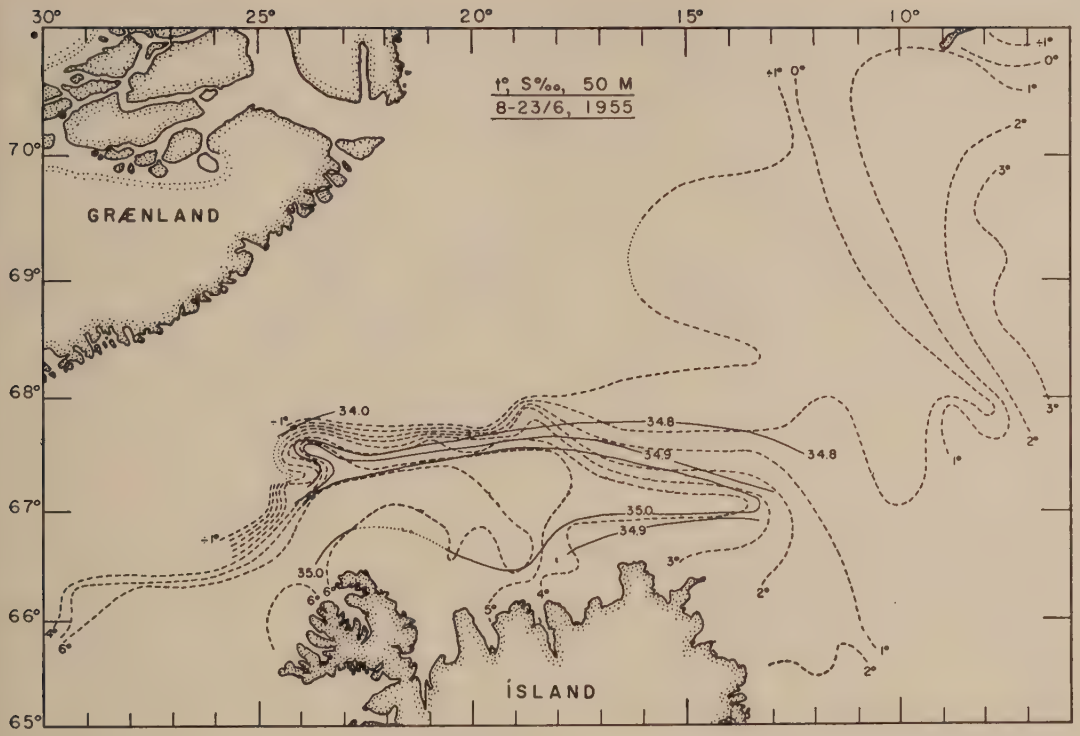


Figure 42. Temperature and salinity at 50 m. in June 1955. (Fig. 43, see next page).

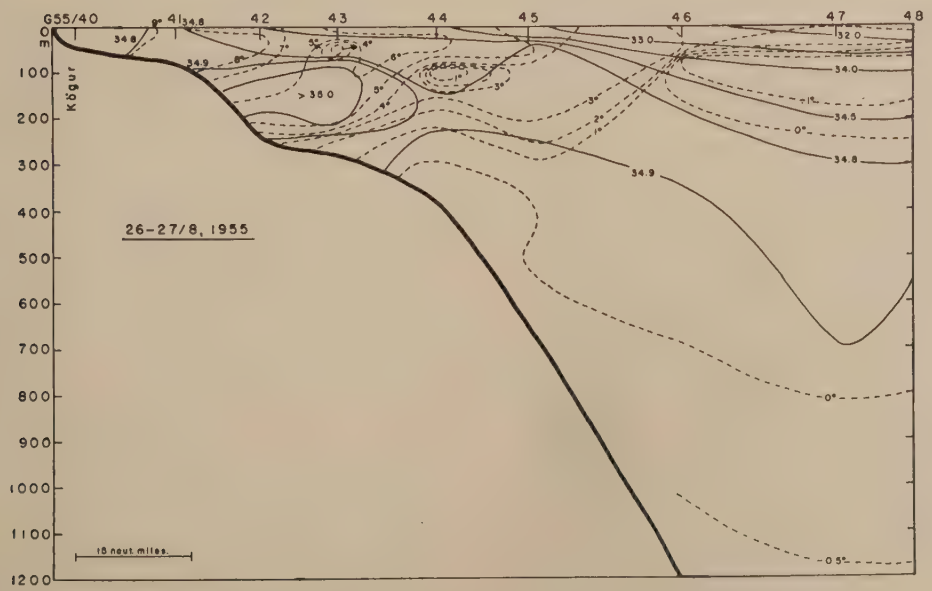


Figure 44. Distribution of temperature and salinity in a section N.N.W. of Kögur, 26.—27. August 1955.

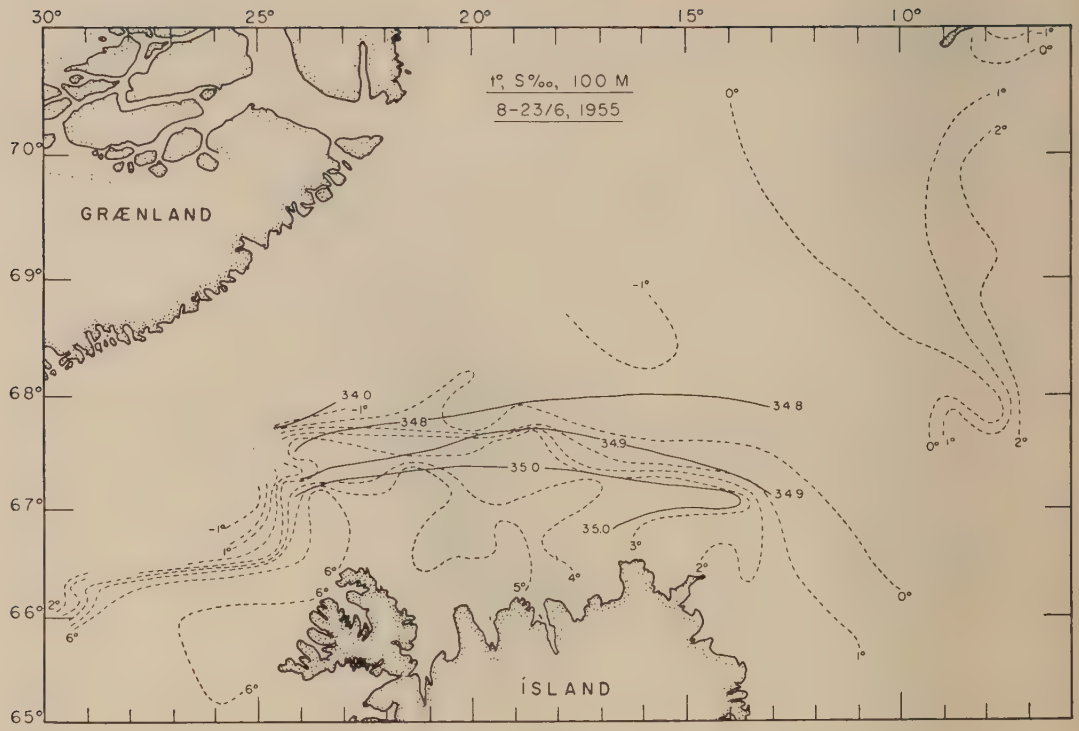


Figure 43. Temperature and salinity at 100 m. in June 1955.

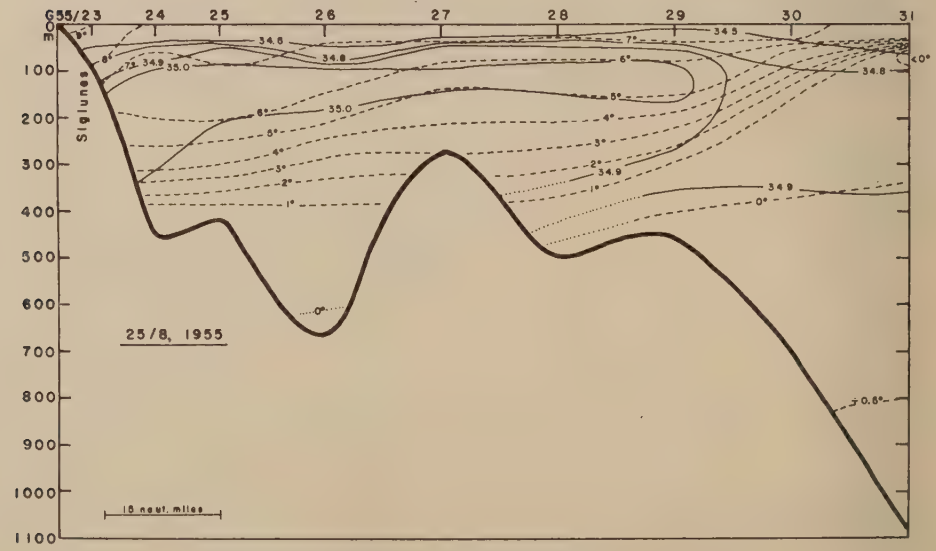


Figure 45. Distribution of temperature and salinity in a section north of Siglufjörður, 25. August 1955.

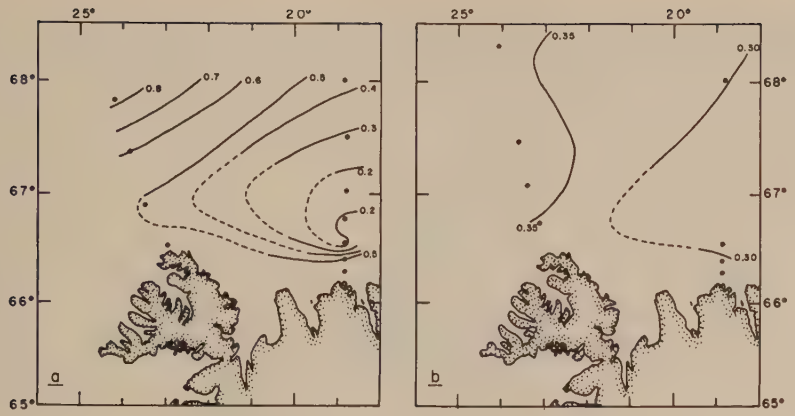


Figure 46. Distribution of inorganic phosphates at 20 m., a in June, b in August 1955.

also somewhat more extensive in 1954 and 1953, especially in the region east of Langanes.

Numerous BT stations were worked during July and the first half of August, and chemical and hydrographical observations were repeated in the western part of the area during the second half of August. In the section N.N.W. of Kögur (Fig. 44) the distribution of Atlantic water was decidedly less than in June in the surface layers as well as at subsurface depths. Outside the shelf the south-west-going East Greenland Current was weaker than in June, as indicated by dynamical calculations, and in the northernmost part of the section which this time extended more than half way across the Iceland-Greenland Channel, the current appears to have been very weak. Off Siglufjörður (Fig. 45) the amount of Atlantic water was similar to what it was in June, but as usually observed the Atlantic water was found to lie deeper in August.

In the spring of 1955 phytoplankton was much less abundant than in the preceding year. Determinations of dissolved oxygen in the region north of Siglufjörður revealed that the percentage saturation in the surface layers was about 112—118 in the spring of 1955 against 120—130 in 1954. It may thus be concluded that the plant production was less active in 1955.

Thermocline was distinctly more apparent than in 1954, the stability greater and in consequence the amount of inorganic phosphates above the thermocline smaller, being 0.2—0.5 µg.a./l. at 20 metres in June in the region west of Grimsey (Fig. 46a) as compared to 0.5—0.7 µg.a./l. in 1954. In July the phosphate content decreased below 0.1 µg.a./l. in the section north of Siglufjörður, but increased in August to about 0.3 µg.a./l. (Fig. 46 b) in spite of greater stability of the water in August than in July.

Unnsteinn Stefánsson

Sections Faroes to East Greenland and Cape Farewell to West Ireland

(Figures 47-49)

Two transatlantic sections were worked from R/V "Dana", the section along 62°N. from the Faroes to East Greenland from 1. to 7. July (Fig. 48) and from Cape Farewell to Ireland from 13. to 21. August (Fig. 49).

As in 1954 the warm Atlantic water with temperatures above 8°C. was found in great thickness in the eastern part of the section (Fig. 48). Over the slope off the Faroes relative cold water indicate an overflow of Norwegian Sea deep water over

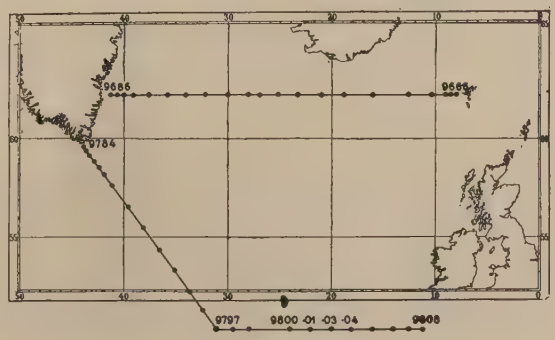


Figure 47.

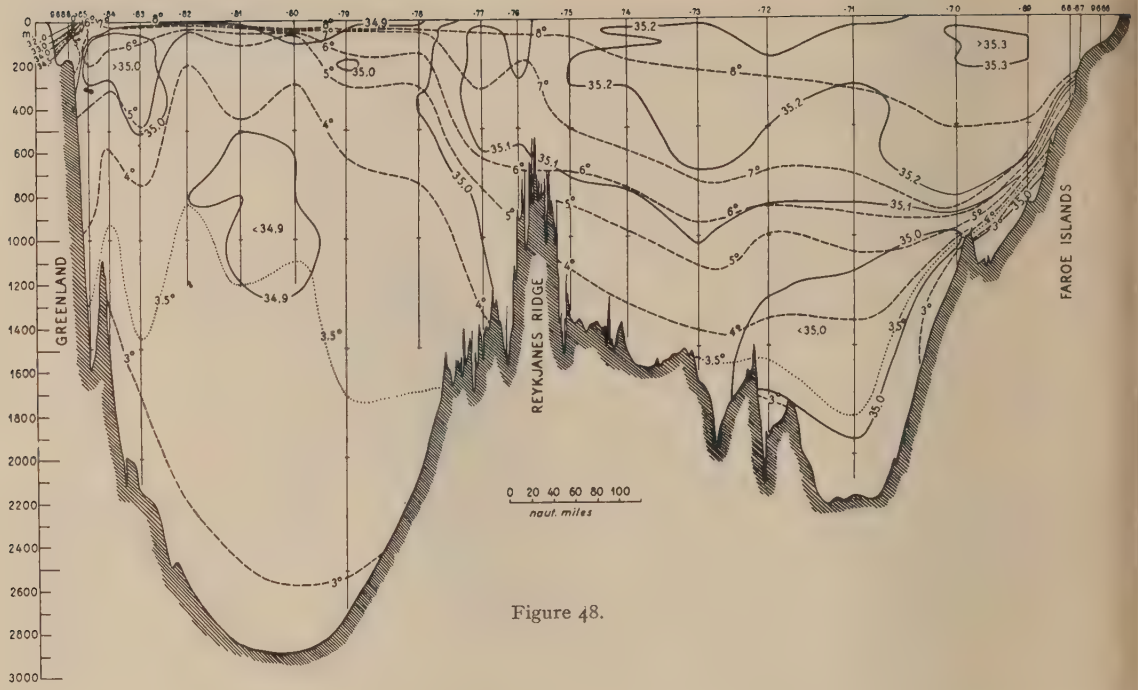


Figure 48.

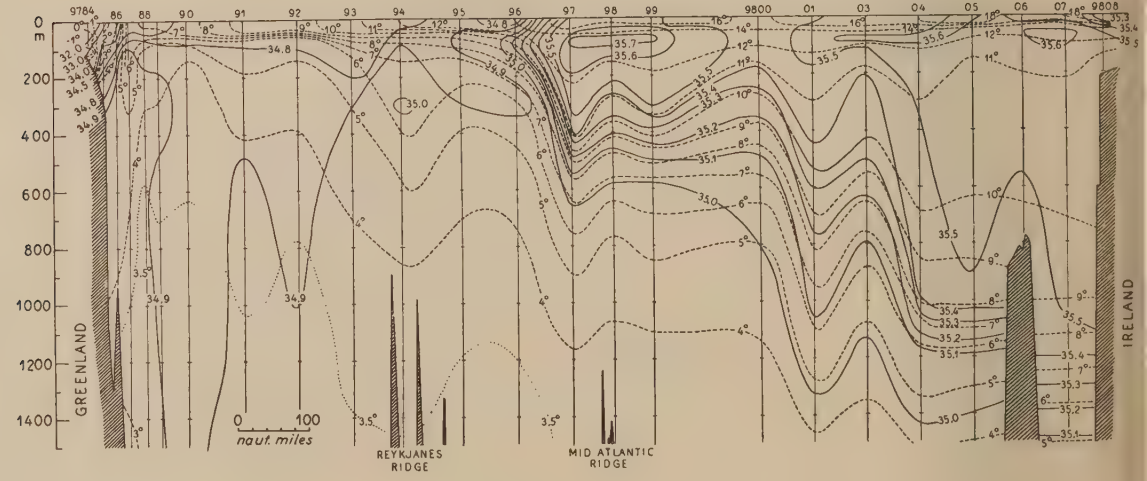


Figure 49.

the Faroe-Iceland Ridge or between the Faroes and Faroe Bank. The bottom water with salinity above 35‰ found in the deep eastern basin must be a mixture of Norwegian Sea deep water and Atlantic water.

West of the Reykjanes Ridge the strong inclination of the isotherms and isohalines indicate a strong north-going current, the Irminger Current. In the western part of the section the East Greenland Polar Current was found over the Greenland Shelf and outside the shelf was the south-going branch of the Irminger Current. Only small amounts of Atlantic water was found in the Irminger Sea.

In the Greenland-Ireland section the Polar Current seems to be of greater volume than usual and it is remarkable that temperatures below —1° was met here as late as the middle of August. The Irminger Current was not so well developed and its core with temperatures above 5°C. was situated far from the shelf.

One of the most striking features in the section is the sharply defined front between the subarctic water and the warm and saline water between Stations 9796 and 9797. The front is found in the south-eastern part of the trough between the Reykjanes Ridge and the Mid-Atlantic Ridge. This front was found in nearly the same position in 1954 and seems thus to be closely connected with the bottom configuration.

The inclination of the isotherms between Stations 9800 to 9801 and 9803 to 9804 indicate strong north-going currents in these positions.

F. Hermann

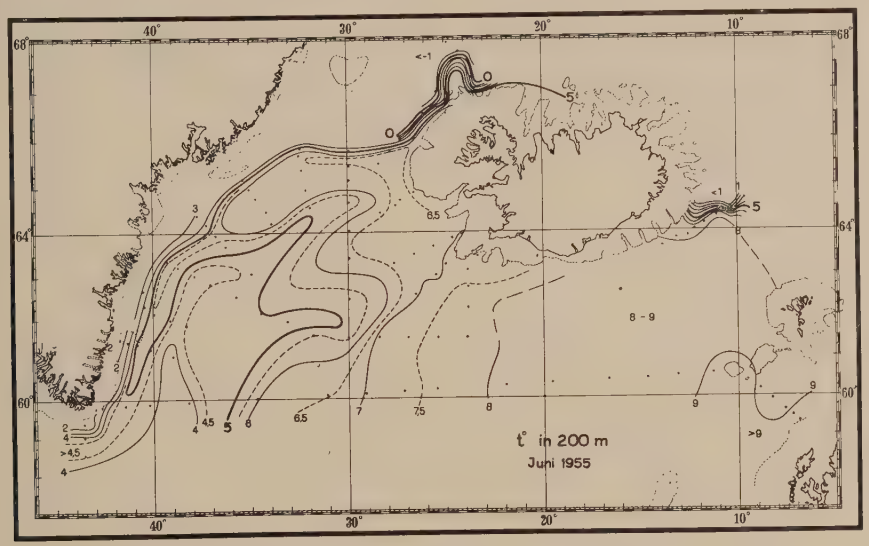


Figure 50. Temperature at 200 m., June 1955.

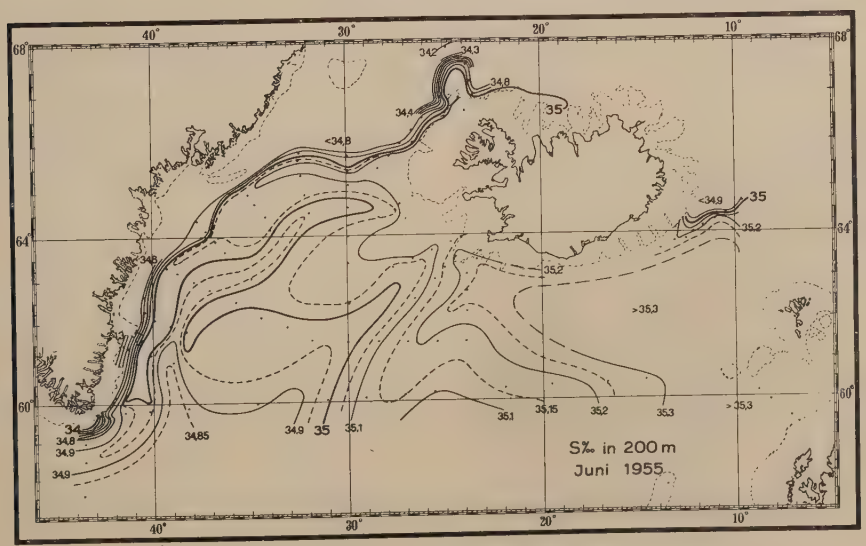


Figure 51. Salinity at 200 m., June 1955.

Stratification and Circulation of the Irminger Sea in June 1955

(Figures 50-55)

During the first oceanic research cruise from 28. May to 10. July 1955 by the new German fisheries research vessel "Anton Dohrn" the hydrographic stratification and circulation in the Irminger Sea was investigated also. A detailed treatment of the results is being prepared[1]) together with further contributions by other participants in the cruise.

The 126 hydrographic stations worked, the positions of which are shown in Figure 50, were distributed in such a way that a quasi-synoptical survey of the conditions from the surface down to the bottom could be carried through. Figures 50 and 51 show the horizontal distribution of temperature and salinity at a depth of 200 m., Figures 52 and 53 the vertical distribution of temperature and salinity in a section from North Scotland to South Greenland along 60°N.

Four main water masses of different origin can be recognized from the charts and sections, viz.:—

1) Comparatively warm (>5°C.) north-east Atlantic water of high salinity (>35.0‰), belonging to the Gulf Stream system.

2) Moderately cold (3—4°C.) Irminger Sea water, of lower salinity (34.8—34.95‰), extending into great depths of the Irminger Sea by vertical convection due to the winter cooling.

3) Very cold (<3°C.) arctic deep water, of lower salinity (34.8—34.95‰) which is formed in the Norwegian Sea by the wintry vertical convection. It flows over the Greenland-Iceland and Iceland-Faroe Ridges, sinking down south of these, as the so-called subarctic bottom water, into the great depths of the Irminger Sea and the north-east Atlantic Ocean.

4) Very cold (<3°C.) East Greenland water, of low salinity (<34.8‰) and low density, occupies a thin layer near the surface.

The outstanding feature of the Denmark Strait is that three water masses of different origin (types 1, 3, 4) get together here in a single mixing area. As can be seen from the section (Fig. 54), running from north-east to south-west through the deep cross channel of the Denmark Strait, there is arctic deep water, which forms an isolated mass in the channel. This observation can be interpreted in the manner that the renewal of the arctic bottom water in the Irminger Sea takes

[1]) G. Dietrich: Schichtung und Zirkulation der Irminger See im Juni 1955 auf Grund von Untersuchungen mit "Anton Dohrn". Ber. Dtsch. Wiss. Komm. Meeresf., N.F., **15** (in preparation).

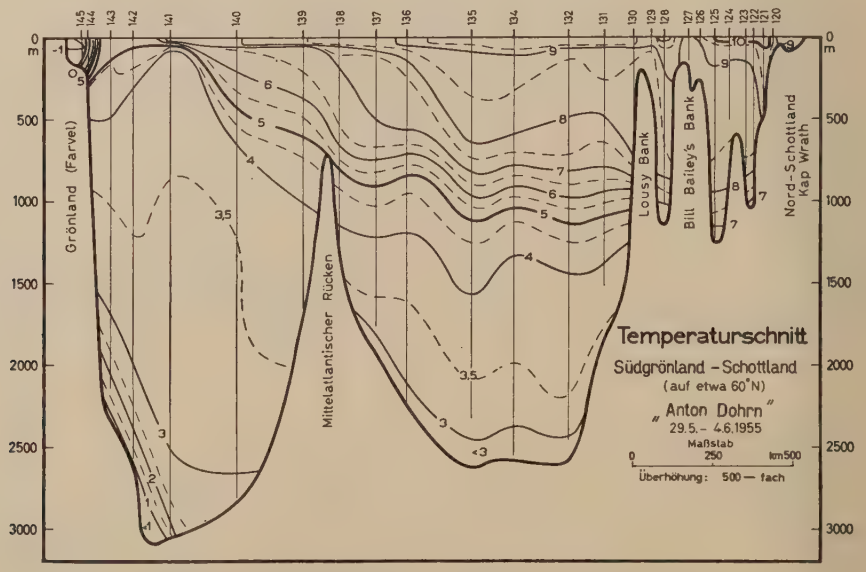


Figure 52. Temperature in a section from North Scotland to South Greenland along 60° N., 29. May to 4. June 1955.

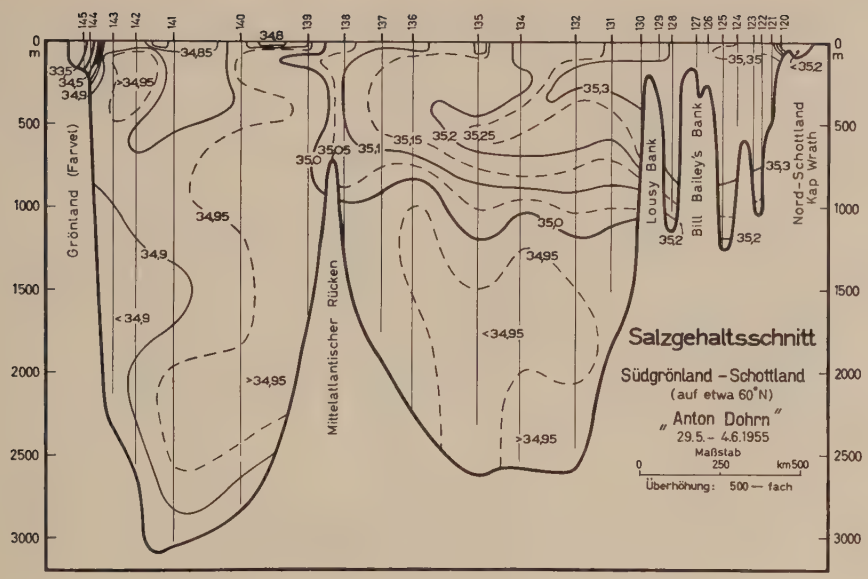


Figure 53. Salinity in a section from North Scotland to South Greenland along 60° N., 29. May to 4. June 1955.

place at intervals. The same water also washes the bottom of the shallower parts of the Denmark Strait bordering on the cross channel to the west. In this area, near the transition to the neighbouring Atlantic water (type 1) good catches of redfish (*Sebastes marinus*) were made.

Based on the hydrographic observations supplied by "Anton Dohrn", the topography of the physical sea surface was determined (Fig. 55). Considering the continuity condition and other arguments, the zero level of the movement was laid at a depth of 800 m. in the central Irminger Sea and 1400 m. in the north-east Atlantic Ocean. The given contours in dynamical centimetres are at the same time the current lines of the surface currents, their distance from each other being a measure of the velocity as shown in the upper left part of Figure 55.

According to these results the waters of the Irminger Sea form a great cyclonic (counter-clockwise) movement. The central Atlantic Ridge greatly influences the splitting up of the current flowing to the north, which originates from the Gulf Stream system. The East Greenland Current flows over the Continental Slope at velocities of up to 25 cm./sec. The actual Irminger Current is a comparatively weak current at the south and west side of Iceland.

G. Dietrich

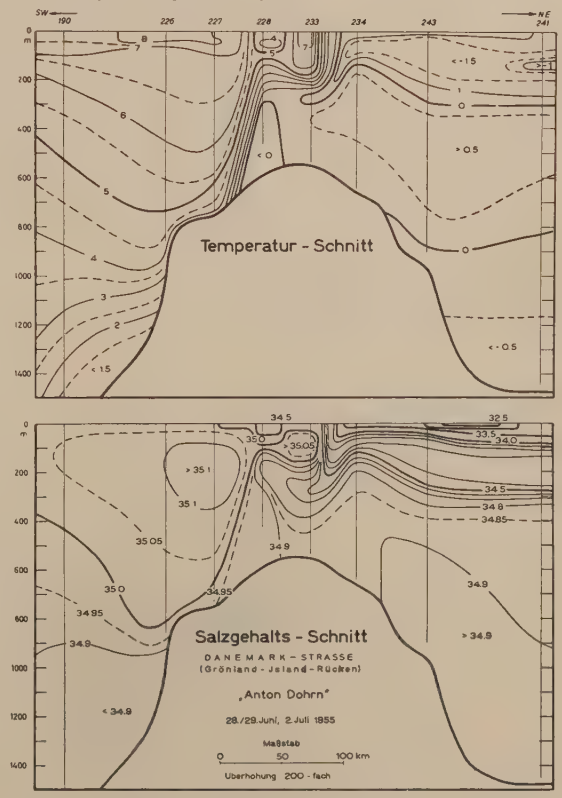


Figure 54. Temperature and salinity in a section to the cross channel of Denmark Strait, 28.—29. June and 2. July 1955.

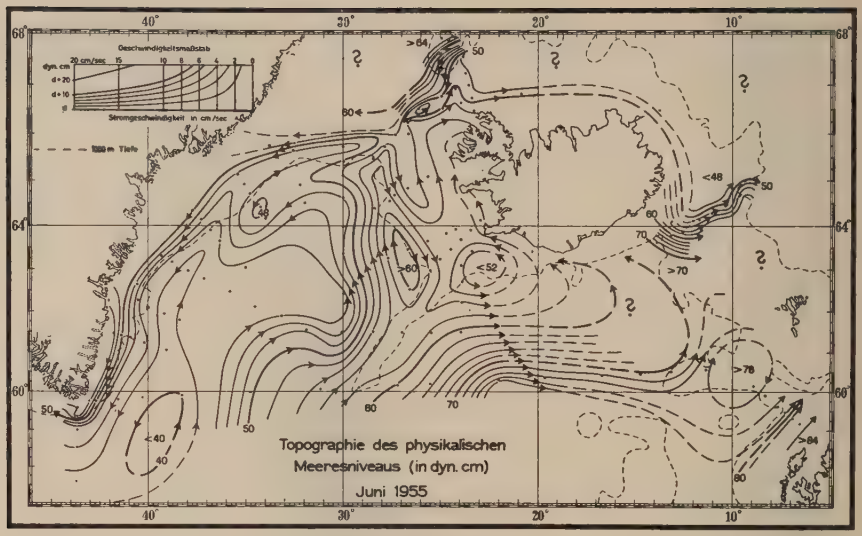


Figure 55. Physical topography of the sea surface in dyn. cm., June 1955.

Hydrographic Investigations by the R/V "Anton Dohrn" in Greenland Waters, September—October 1955

(Figures 56-58)

From 13. September to 14. October the R/V "Anton Dohrn" carried out hydrographic investigations on the East and West Greenland Shelf between Denmark Strait and Disko. Ice conditions allowed the ship to advance up to the coastal waters. Ninety-six hydrographic stations and 300 surface observations were made.

Figures 56 and 57 show the temperature and salinity distribution at 100 m. depth. It is remarkable that there is no fundamental difference

Figure 56. Temperature at 100 m. in September-October 1955.

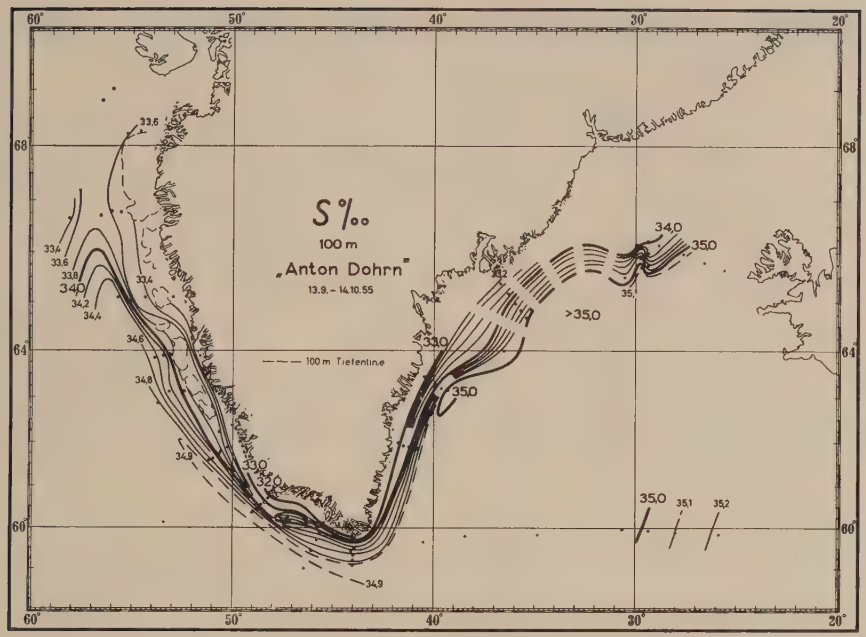


Figure 57. Salinity at 100 m. in September-October 1955.

between the hydrographic conditions of the East and West Greenland Currents. Temperature and salinity decrease strongly towards the coast within the entire Greenland current system. The isoline run nearly parallel to the coast. The East and West Greenland Currents are therefore composed of a warm and a cold component, and in some regions they are divided by a sudden temperature transition, but in other regions the transition is gradual.

Figure 56 shows that the West Greenland banks are found only in the cold water region (2° C.). The temperature is slightly higher on the Disko Bank only, where the water column is very homogeneous. This heating is apparently caused by radiation. In the Davis Strait the cold water of the Canadian Polar Current advances very far to the east.

Figure 58 shows a section across the East Greenland Current. The density distribution is controlled by the great salinity differences. Therefore the Greenland current system is apparently caused by the salinity distribution.[1])

A very interesting tongue of water was found in the Denmark Strait region. This tongue consisted of water of the East Greenland and Irminger Currents and was placed above the cold and relatively saline bottom water which advances across the Iceland-Greenland Ridge into the Irminger Sea. The tongue seems to have been there for some time. Below this tongue, in the subarctic bottom water, very high redfish concentrations were discovered.

W. Krauss

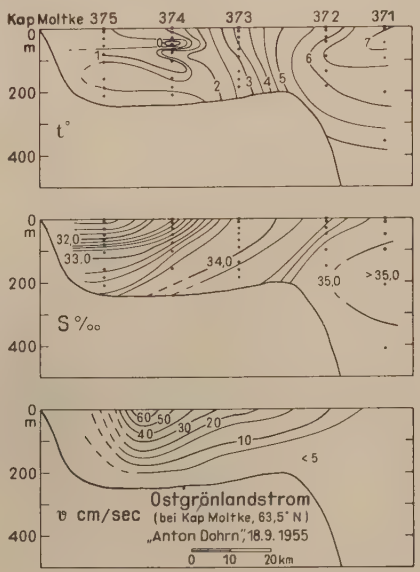


Figure 58. Temperature, salinity, and velocity in a section off Cape Moltke.

[1]) W. Krauss: "Zum System der Meeresströmungen in den höheren Breiten". Dtsch. Hydrogr. Zeitschr., 8, p. 102. 1955.

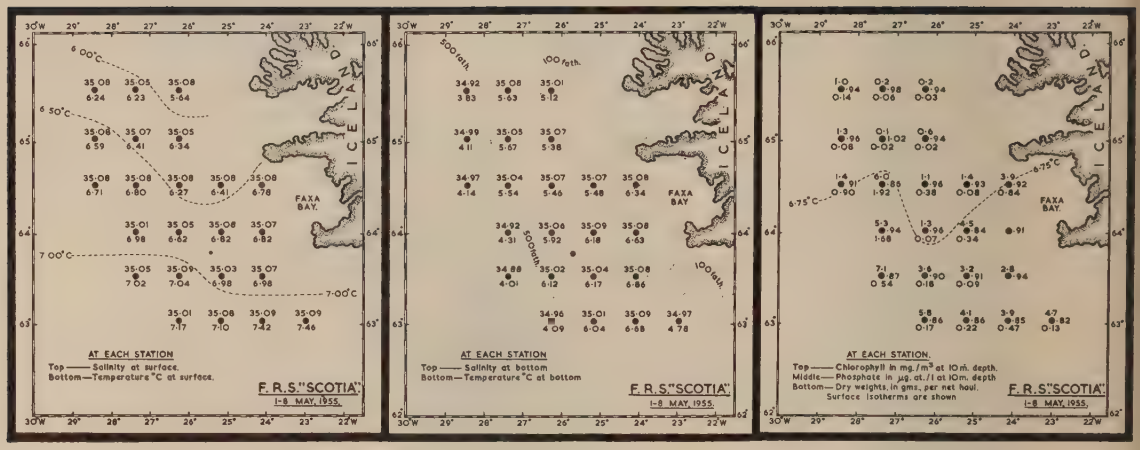


Figure 59.

Figure 60.

AT EACH STATION.
Top —— Chlorophyll in mg./m³ at 10 m. depth.
Middle— Phosphate in µg. at./l at 10m. depth
Bottom— Dry weights in gms. per net haul.
Surface Isotherms are shown
F.R.S."SCOTIA".
1-8 MAY, 1955.
FAXA BAY.
ICELAND

Figure 61.

Hydro-Biological Survey in Denmark Strait, May 1955

(Figures 59-61)

From 1. to 8. May 1955 the Scottish research vessel "Scotia" carried out a hydro-biological survey in the Denmark Strait in connexion with halibut investigations. This survey covered fewer stations than in the previous year. Their positions are shown in the figures, which indicate temperatures and salinities at the surface (Fig. 59) and the bottom (Fig. 60).

In Figure 60 the cold and less saline bottom water is seen to lie beyond the 500 fathom contour. Since no two deep stations lay across the general direction of the Irminger Current, measures of this current were not possible this year. The salinity above this bottom water, however, was generally uniform at a lower level than that found in May 1954. Also, there was only a general northerly temperature decrease. These two features would suggest that there had been no recent great intrusion of warm saline Atlantic water.

Data concerning the plankton production in the area are given in Figure 61. The facts that the water column was nearly homogeneous down to 100 metres throughout the whole area, and that phosphate values were high and dry weights low suggest that there had been negligible plant production since the winter. Yet there was a great range of chlorophyll concentrations. The lowest values were found in the north and the decrease appears to be related to the changes in temperature as shown by the 6.75°C. isotherm. The low concentrations in the north are typical of winter coastal waters, but an explanation of the high southerly values requires further study.

At each station three 1 m. silk townets of No. 16 mesh were towed for $1^1/_4$ hours between 600 m. and surface or, in shallow water, between bottom and surface. Six halibut eggs were found in the collections, and details of depth and position are as follows:—

Position	Depth of haul	Total depth	Number of eggs
63° 00′ N., 25° 10′ W.	300 m.	686 m.	1
63° 30′ N., 27° 20′ W.	400 m.	1,188 m.	1
65° 30′ N., 28° 25′ W.	600 m.	1,070 m.	1
	400 m.		2
64° 30′ N., 28° 25′ W.	500 m.	1,170 m.	1

These eggs were taken over fairly deep water, but some of them may have been produced by the halibut concentrations found in the northern part of the area surveyed, in depths from 240 to 460 metres. Samples obtained by "Scotia" from these concentrations showed that of ten females caught, all were spent. Market samples from commercial vessels fishing at this time in the same area indicate that the population ranged between 99—150 cm. in length and 11—16 years in age.

A. D. McIntyre

J. H. Steele

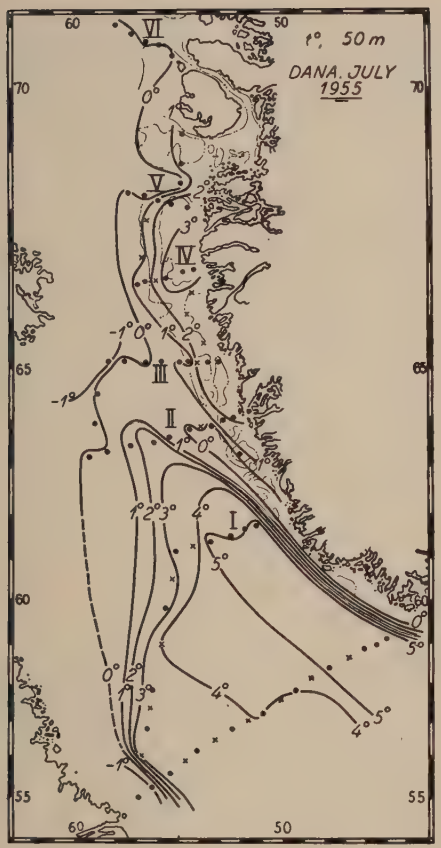


Figure 62. Temperature distribution at 50 m. and location of sections, July 1955.

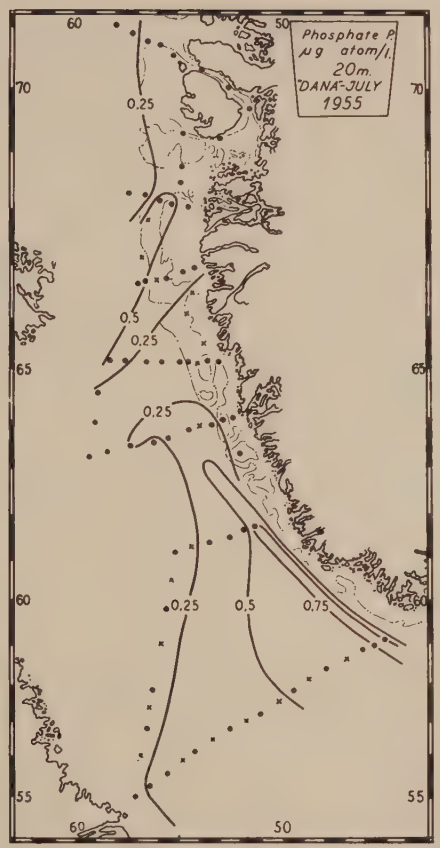


Figure 63. Distribution of phosphate, July 1955.

Hydrographic Conditions in the Eastern Part of the Labrador Sea and the Davis Strait, 1955

(Figures 62-70)

In July 1955 the Danish R/V "Dana" worked the hydrographic stations shown in Figure 62. Ice conditions were unusually severe at West Greenland in 1955. The East Greenland Polar Current carried great accumulations of heavy "storis" round Cape Farewell and up along the west coast where it was found as far north as Fiskenæs Bank in July. Owing to the ice the eaternmost stations of the Cape Farewell and Frederikshåb sections could not be worked.

Figure 62 shows the temperature distribution at 50 m. and location of sections I to VI. As might be expected from the distribution of the ice the arctic component of the West Greenland Current was strongly developed and caused negative water temperatures as far north as west of Fylla Bank and low temperatures over the banks south of Fylla Bank.

The temperature was slightly below normal over the shallow part of Fylla Bank and considerably below normal on the western slope. Over Lille Hellefiske Bank and Store Hellefiske Bank conditions were about normal.

The Atlantic component of the West Greenland Current, the Irminger Current, was also well developed off the middle part of West Greenland, but its core was situated deeper and further westward from the banks than usual. Consequently it exerted only a slight influence on the conditions on the banks. It is remarkable that higher temperatures were found in section III in this warm undercurrent than in the more southerly Fylla Bank section (II). As, moreover, this current does not seem to be well developed in the incomplete Frederikshåb section there is reason to believe

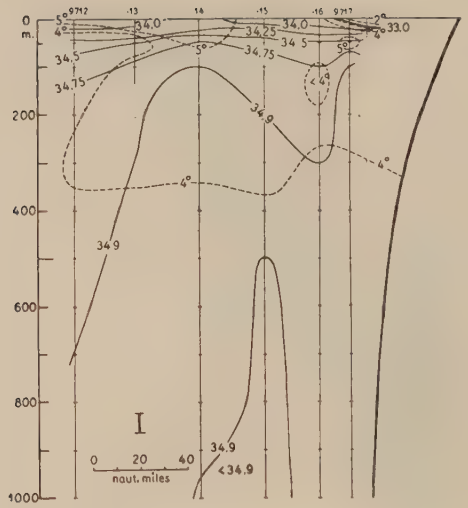


Figure 64. Section I: off Frederikshåb, 14.—15. July 1955.

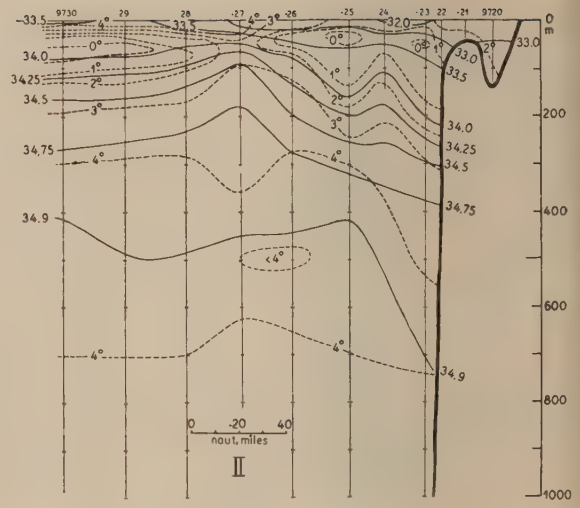


Figure 65. Section II: across Fylla Bank, 20.–22. July 1955.

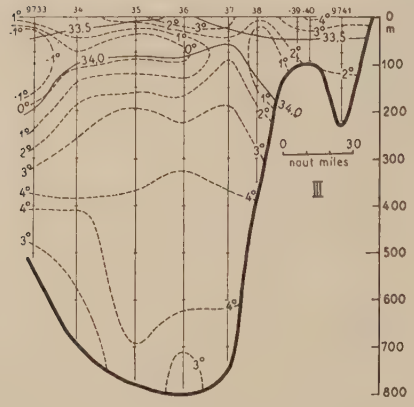


Figure 66. Section III: across Lille Hellefiske Bank, 22.—23. July 1955.

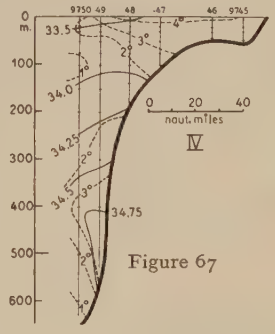


Figure 67

Figure 67. Section IV: across Store Hellefiske Bank, 24.—25. July 1955.

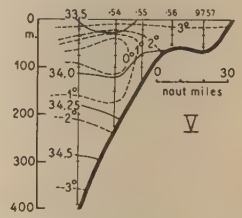


Figure 68

Figure 68. Section V: off Egedesminde, 25.—26. July 1955.

that the warm current was decreasing in strength during the time of observation.

Phosphate determinations were made for the upper 100 metres and Figure 63 shows the distribution of phosphate at 20 m. As in previous years a maximum of phosphate was found off the western slope of the banks. Higher concentrations than usual were found in the northernmost part of the area.

Observations from the M/C "Adolf Jensen" showed that the temperature over the shallow

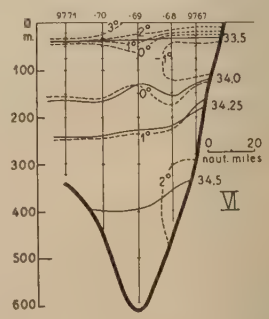


Figure 69. Section VI: off Hareø, 30. July 1955.

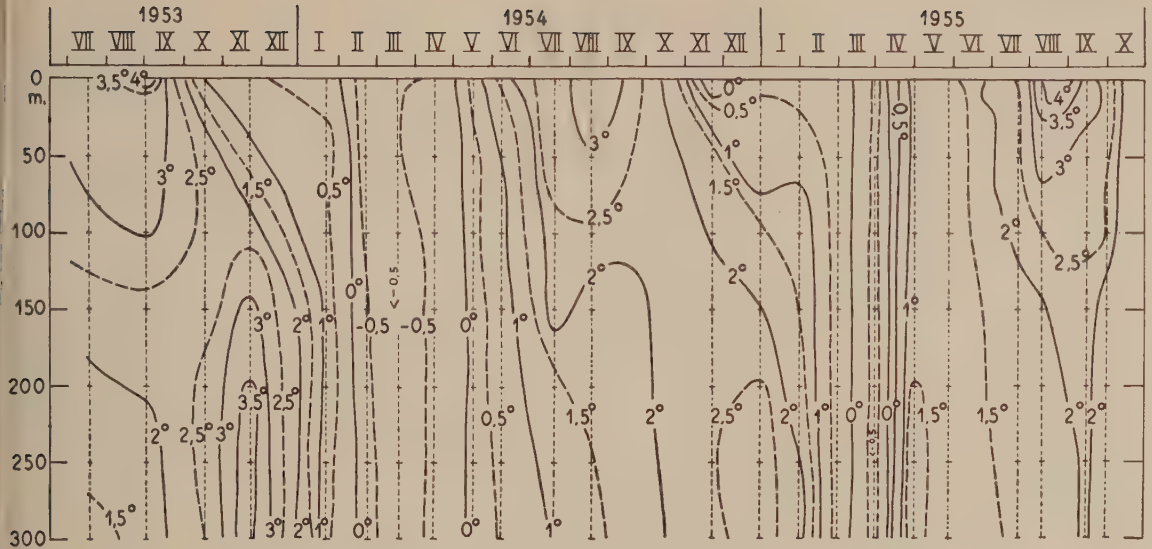


Figure 70. Variation of temperature at the entrance of Godthåb Fjord.

part of Fylla Bank on 31. March was as low as —0.7° and on 11. May it had increased to 0.4°C. over the bottom.

At the entrance of the Godthåb Fjord (64°07'N., 51°53'W.) a hydrographic station was worked, as often as it was possible, throughout the year from the M/C "Adolf Jensen". These observations are of more than local interest as it is believed that many of the features in the variation of temperature are representative of those of the central part of the West Greenland area.

Figure 70 shows the variation of temperature at this station from July 1953 to October 1955. It is remarkable that the maximum bottom temperature is reached so late as November or December which indicates a strong influence of the warm Irminger Current at that time. The maximum temperature at the bottom was considerably higher in 1953 than in 1954. In March the effect of the winter cooling had reached the bottom and nearly uniform temperatures, below –0.5°, was found both in 1954 and 1955.

F. Hermann

Plankton

Scottish Plankton Investigations in 1955

Most of the plankton collections taken by the Scottish research vessels in 1955 were taken in the area now defined as the Near Northern Seas, but some cruises of the "Scotia" extended into the Distant Northern Seas area. These were the April cruise to Icelandic waters and the Denmark Strait, the July cruise to the Outer Banks north-west and west of the British Isles, and the surveys for the planktonic stages of haddock on the Faroe Plateau.

Phytoplankton

In April, south-east of Iceland, there was a dense patch of *Chaetoceros decipiens* and *Nitzschia seriata* which thinned out along the Faroe-Iceland Ridge towards Faroe. These species were abundant again on the north side of the Faroe Channel between Faroe Bank and the Butt of Lewis, and continued to be the dominant species there from April to July when the numbers of *Chaetoceros debilis* increased and lasted until November. South of Iceland, in April, the dominant species was *Rhizosolenia alata gracillima*.

The flora of the south side of the Faroe Channel differed from that of the north side, and there it was dominated by *Rhizosolenia styliformis, R. alata gracillima* and *Chaetoceros decipiens*. There is evidence of this flora continuing northwards, west of Faroe, towards the Faroe-Iceland Ridge in July as well as continuing through the Faroe Channel towards Shetland. West of this patch dinoflagellates predominated in July, the chief species being *Ceratium longipes, C. fusus, C. tripos* and *C. furca*. Late in the year *Halosphaera* became abundant at Faroe.

Zooplankton

The spring *Calanus* production in the Faroe-Shetland and Faroe-Iceland areas was rich in 1955 but by midsummer was being quickly replaced by an oceanic fauna which was poor in crustaceous plankton. The main inflow of this oceanic fauna from the Atlantic to the west of the British Isles continued into the Faroe Channel, particularly towards the south side (i. e., in the Near Northern Seas area), but a branch extended northwards to the west of Faroe carrying the fauna with it to the Faroe-Iceland Ridge. This included *Salpa fusiformis*, the siphonophores *Chelophyes appendiculata* and *Lensia conoidea*, the medusa *Solmaris corona, Arachnactes* larvae and the radiolarian *Thalassicolla*. Other less tolerant species such as the siphonophores *Vogtia, Hippopodius* and *Rosacea*, the medusae *Rhopalonema* and *Atolla*, and *Nectonemertes pelagica* were not found so far north. The oceanic fauna in the Distant Northern Seas area thus contained Lusitanian species only in its south-eastern extremity and was chiefly derived from the open Atlantic. Out in the Atlantic, beyond 11°W., *Aglantha* was very abundant in the upper layers but deeper sampling showed *Salpa fusiformis* to be abundant there below 250 metres.

Investigations with an Icelandic pelagic trawl fitted with a small mesh cod-end, in areas over the banks and deep water west and north-west of the British Isles showed that sonic scattering in the subsurface layers was due to small fish. Behaviour differences could be used to distinguish between the traces caused by *Gadus poutassou*, 8—14 mm., and those caused by *Myctophum* spp., *Stomias*, etc. It was found that the distribution of *G. poutassou* followed closely that of salps. Experiments with nets at different depths clearly showed that salps, even in immense quantity, caused no visible scattering on the machines in use on the "Scotia". Similar experiments showed that dense quantities of *Calanus* were equally ineffective as sonic reflectors.

An unexpected trace on Rosemary Knoll proved to be due to a large penaeid prawn *Funchalia*. A specimen of what appears to be a new species of the salmonid fish *Nansenia* was found off the edge of the shelf; it is being dealt with by the British Museum.

J. H. Fraser

THE FISH

Plaice

Marking Experiments on Plaice in Faxa Bay in 1953 and 1954

(Figures 71-74; Tables 3-6)

Since May 1953 marking experiments have been carried out every 3 months in Faxa Bay. Plaice, cod, and haddock have been marked. Other marking experiments of plaice in recent years have been carried out in 1947 by J. Jónsson and in April 1951 by H. Einarsson[1].) The results from Mr. Jónsson's experiments are not available, but will, it is hoped, be dealt with later. The material from recaptures up to 1. January 1956 has now been worked up and the main results will be discussed here.

The recaptures are divided according to areas as shown in Figure 71[2]).

As regards the marking experiments of 1953 and 1954 Tables 3 and 4 give the areas of recapture, number of fish recaptured in each area, the percentage of all taggings, the percentage of recoveries and the nationality of the fishing vessels concerned.

It appears that Faxa Bay supplied the largest numbers of the Icelandic recaptures and that area 7 comes next in order. The British recoveries, however, are mostly from areas 3 and 7. There are only few recaptures by other nationals.

Figures 72 and 73 illustrate the main features from Tables 3 and 4 and from the corresponding data of the marking experiments in 1951, when

[1]) Data from a paper (in MS.) have kindly been placed at my disposal.

[2]) From Fridriksson, Rapp. et Proc.-Verb., **120**, p. 63.

Figure 71. The division of different areas of the waters round Iceland.

677 fish were marked; 101 of these were recaptured. The histogram on Figure 72 shows the percentage of recoveries according to areas. The hatched columns show experiments carried out in 1951, the open columns show the experiments undertaken in 1953, and the black columns the experiments in 1954.

As regards the 1953 and 1954 markings it is of interest to note the many recoveries made in areas 3 and 7 (Fig. 72). This is especially apparent in area 7 in regard to the 1954 experiments where the number of recaptures even exceeded those from Faxa Bay.

The last columns in Figure 72 show the percentage of recoveries made outside Faxa Bay. It is clearly seen that these amount to between 60 and 70%.

Table 3. Recaptures from Marking Experiment on Plaice in Faxa Bay 1953
(Total tagged : 2020)

Area of recapture	1			3			7			8			Position unknown			Total		
Nationality of vessels	Number of specimens	% tagged	% recoveries	Number of specimens	% tagged	% recoveries	Number of specimens	% tagged	% recoveries	Number of specimens	% tagged	% recoveries	Number of specimens	% tagged	% recoveries	Number of specimens	% tagged	% recoveries
Iceland	46	2.3	34.1	1	0.05	0.7	14	0.7	10.4	1	0.05	0.7	5	0.2	3.7	67	3.3	49.6
Great Britain	—	—	—	40	2.0	29.6	13	0.6	9.6	3	0.1	2.2	6	0.3	4.4	62	3.1	45.9
Faroes	—	—	—	—	—	—	1	0.05	0.7	—	—	—	—	—	—	1	0.05	0.7
Germany	1	0.05	0.7	1	0.05	0.7	—	—	—	1	0.05	0.7	1	0.05	0.7	4	0.2	3.0
Belgium	—	—	—	—	—	—	1	0.05	0.7	—	—	—	—	—	—	1	0.05	0.7
Total	47	2.3	34.8	42	2.1	31.1	29	1.4	21.5	5	0.2	3.7	12	0.6	8.9	135	6.7	100.0
Recaptured outside Faxa Bay ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	84	4.2	62.2

Table 4. Recapture from Marking Experiments on Plaice in Faxa Bay 1954
(Total tagged : 2194)

Area of recapture	1			3			4			7			8			Position unknown			Total		
Nationality of vessels	Number of specimens	% tagged	% recoveries	Number of specimens	% tagged	% recoveries	Number of specimens	% tagged	% recoveries	Number of specimens	% tagged	% recoveries	Number of specimens	% tagged	% recoveries	Number of specimens	% tagged	% recoveries	Number of specimens	% tagged	% recoveries
Iceland	37	1,7	29.8	1	0.05	0.8	—	—	—	23	1.0	18.5	3	0.1	2.4	4	0.2	3.2	68	3.1	54.8
Great Britain	—	—	—	25	1.1	20.2	1	0.05	0.8	12	0.5	9.7	—	—	—	8	0.4	6.5	46	2.1	37.1
Faroes	—	—	—	—	—	—	—	—	—	5	0.2	4.0	—	—	—	1	0.05	0.8	6	0.3	4.8
Germany	—	—	—	—	—	—	—	—	—	—	—	—	2	0.1	1.6	—	—	—	2	0.1	1.6
Belgium	—	—	—	—	—	—	—	—	—	1	0.05	0.8	1	0.05	0.8	—	—	—	2	0.1	1.6
Total	37	1.7	29.8	26	1.2	21.0	1	0.05	0.8	41	1.9	33.1	6	0.3	4.8	13	0.6	10.5	124	5.7	100.0
Recaptured outside Faxa Bay	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	83	3.8	66.9

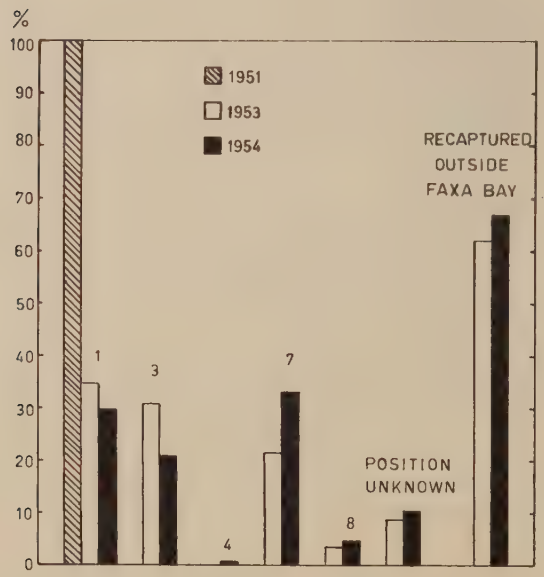


Figure 72. Recoveries according to areas.

These results seem to indicate, that the plaice migrate from the feeding grounds in Faxa Bay, when the adult stage is reached. However, it seems probable that part of the stock migrate to and fro according to the different seasons, but the available data are not extensive enough to permit any conclusions to be drawn as to this question.

In contrast to the results of the 1953 and 1954 experiments, the recaptures from the 1951 experiment were all made inside Faxa Bay (Fig. 72). Of these nearly all the recaptured fish were caught within four months from the marking and 68% during the first month (Table 6). According to reliable information a great number of tagged plaice were thrown overboard from an Icelandic fishing vessel shortly after the 1951 marking experiment was made.

As the percentage of known recoveries from the 1951 experiment was much greater than from the 1953 and 1954 experiments (14.9% as compared to 6.7 and 5.7% respectively) in spite of the fact that there is strong reason for presuming that a considerable number of the tagged fish from the

Table 5. Length Distribution of Plaice from Marking Experiments in Faxa Bay 1953 and 1954

		Length groups, cm.										
		11–15	16–20	21–25	26–30	31–35	36–40	41–45	46–50	51–55	56–60	Total
All marked in 1953—54	No. of Fish	1	2	120	778	1480	1022	510	147	40	8	4108
	%	0.02	0.05	2.9	18.9	36.0	24.9	12.4	3.6	1.0	0.2	100.0
Recaptured outside Faxa Bay	No. of Fish	—	—	—	7	45	55	46	5	2	1	161
	%	—	—	—	4.3	28.0	34.2	28.6	3.1	1.2	0.6	100.0
Recaptured inside Faxa Bay	No. of Fish	—	—	—	7	27	23	20	4	1	—	82
	%	—	—	—	8.5	32.9	28.0	24.4	4.9	1.2	—	99.9

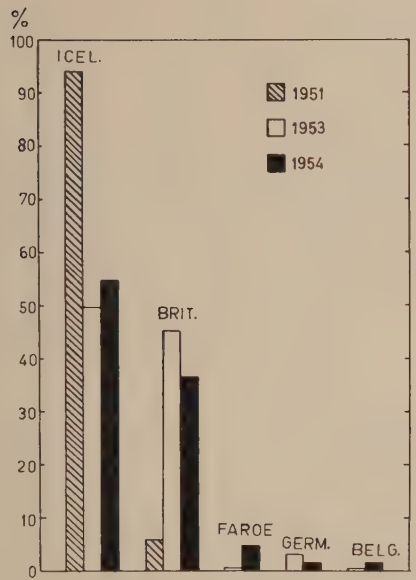


Figure 73. Recoveries according to nationality of fishing vessels.

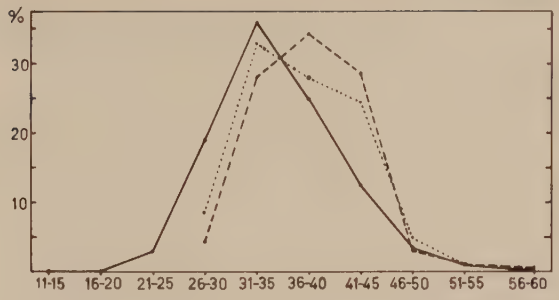


Figure 74. Length distribution of plaice marked in 1953 and 1954.
Solid line indicates all fish marked, hatched line recaptures outside Faxa Bay, and dotted line recaptures inside Faxa Bay. All length measurements are from the time of marking.

1951 experiment were caught without the tags being returned, and furthermore as the recoveries are mostly from the first two months after tagging, it seems evident that the 1951 stock of plaice in Faxa Bay was heavily exploited and that, in all probability, most of the fish were caught before they could migrate out of Faxa Bay as indicated by the fact that no recoveries were made outside the bay.

Figure 74 illustrates the length distribution of all plaice marked in 1953 and 1954, the length distribution of recaptures from outside Faxa Bay, and of recoveries inside the bay (see also Table 5). The diagrams are all based on the length of the fish at the time of marking. It appears from the diagrams that the plaice caught outside the bay consists of the larger individuals of the stock. The same is partly true of the plaice caught inside Faxa Bay, although the average length of these fish is somewhat less than the average length of fish caught outside the bay. The fishing gear used seems to afford the most obvious explanation of this difference. Undoubtedly this explanation holds true to some extent at any rate as regards the plaice caught in Faxa Bay. All recoveries outside Faxa Bay are either taken by trawl with larger meshes than those of our research trawl or in cod net with still larger meshes. The recoveries in Faxa Bay were mostly taken in cod nets or lumpsucker nets, the rest on long-line (9 fish), our research trawl (3), plaice net (1) and, finally, there were a few recoveries with no information as to the fishing gear used. I do not see any reason why there should be more selection of the larger individuals outside than inside the bay.

The peaks of the curves for all marked and recaught plaice in Faxa Bay occur at the same length group, viz., 31—35 cm., but on the diagram for recaptures in Faxa Bay length groups of less than 26—30 cm. are missing, which is undoubtedly due to selection by the gear used. The diagram for recoveries outside Faxa Bay is more symmetrical in shape, which seems to indicate less selection. The peak of this diagram is clearly separated from the other two which coincided with the 31—35 cm. group. This suggests that the largest individuals migrate out of the bay. This is also in accordance with the common experience that the larger individuals are more frequently found in deeper waters.

Table 6 shows the time between the marking and the recapture. In the last column the time is expressed as the average number of months at sea for the different areas. This shows that the average time is shortest for Faxa Bay.

Figure 73 gives the percentage of all recoveries by the different nationalities fishing in the area. As seen on the histogram, the Icelanders have caught about 50 and 55%, the British 46 and 37%, and other nations 4 and 8% of the recaptures from the 1953 and 1954 marking experiments, while the Icelanders have caught 94% and the British 6% of the recoveries from the 1951 marking experiments.

Table 6. Marking Experiments of Plaice in Faxa Bay, 1951

Area of recapture	1951	1953						1954						
Time at liberty (months)	1	1	3	7	8	?	Total	1	3	4	7	8	?	Total
1	68	—	—	—	—	—	—	9	—	—	—	—	—	9
2	16	3	—	—	—	—	3	1	—	—	—	—	1	2
3	4	—	—	—	—	—	—	2	—	—	—	—	—	2
4	1	3	—	—	—	—	3	9	—	—	—	—	—	9
5	—	4	—	—	—	—	4	3	—	—	—	—	1	4
6	—	7	1	—	—	—	8	3	1	—	3	2	—	9
7	—	3	2	1	1	1	8	2	—	—	6	—	—	8
8	1	1	4	3	—	2	10	2	1	—	20	—	1	24
9	—	1	1	—	—	—	2	1	3	—	1	—	—	5
10	—	1	3	—	2	—	6	2	—	—	1	—	—	3
11	—	1	—	1	—	1	3	—	3	—	2	1	1	7
12	—	1	—	—	—	1	2	1	2	—	5	1	1	10
13	—	3	1	—	—	1	5	1	1	—	—	1	—	3
14	—	4	5	—	—	2	11	—	3	—	—	—	—	3
15	—	4	1	—	—	—	5	—	4	—	2	—	1	7
16	—	—	1	—	1	—	2	1	1	1	—	1	1	5
17	—	3	1	2	—	—	6	—	1	—	—	—	1	2
18	—	—	1	1	—	—	2	—	2	—	—	—	—	2
19	—	3	4	3	—	2	12	—	—	—	—	—	—	—
20	—	1	—	4	—	—	5	—	4	—	—	—	—	4
21	—	—	—	9	—	—	9	—	—	—	—	—	—	—
22	—	—	2	—	1	—	3	—	—	—	—	—	—	—
23	—	—	2	2	—	1	5	—	—	—	—	—	—	—
24	—	1	2	2	—	—	5	—	—	—	—	—	—	—
25	—	1	4	1	—	—	6	—	—	—	—	—	—	—
26	—	—	1	—	—	—	1	—	—	—	—	—	—	—
27	—	—	4	—	—	—	4	—	—	—	—	—	—	—
28	—	—	—	—	—	—	—	—	—	—	—	—	—	—
29	—	—	1	—	—	—	1	—	—	—	—	—	—	—
30	—	—	1	—	—	—	1	—	—	—	—	—	—	—
31	—	1	—	—	—	—	1	—	—	—	—	—	—	—
40	1	—	—	—	—	—	—	—	—	—	—	—	—	—
?	10	1	—	—	—	1	2	—	—	—	1	—	5	6
Total	101	47	42	29	5	12	135	37	26	1	41	6	13	124
Average time at liberty (months)	1	10	17	18	12	12	14	4	13	15	8	10	10	8

It might be observed here, that recaptures from both the 1953 and 1954 marking experiments are naturally still being received, which may alter the picture slightly. However, as the duration in the water is longer for the plaice recaptured outside Faxa Bay, the recoveries from outside the bay may be expected to be somewhat more numerous.

A. Sigurðsson

Redfish

Icelandic Redfish Investigations in 1955

(Figures 75–81)

During 1955 three cruises were made with commercial trawlers for the purpose of discovering new fishing banks and investigating the redfish population. On one of these cruises with the M/T "Jón Thorláksson" the East Greenland banks were investigated, whereas the purpose of the two other cruises, with the S/T "Harðbakur", was to investigate the fishing grounds off the north, north-east, and east coast of Iceland.

Cruise 1

From 8. to 17. July the region between 61°30'N., 40°30'W. and 65°10'N., 34°10'W. was surveyed from the trawler "Jón Thorláksson". At this time ice conditions were unfavourable and greatly impeded the observations. Trawling was continued from 17.—23. July in the area around 63°36'N., 37°48'W. The catches consisted mainly of redfish, but only minor quantities of cod, saithe, and halibut were caught. The majority of the material here discussed was sampled in this area. The length measurements totalled 3946 individuals.

The samples collected in the East Greenland area reveal the interesting fact that the length distribution from different hauls may vary greatly. This will appear from Figure 75 which shows a few characteristic curves of the length distribution from different hauls. An appreciable deviation from these typical curves was only found in a few hauls, the curve with the 35—39 cm. group forming the maximum. Some of these curves lack the secondary maximum formed by the 50—54 cm. group, in a few cases a secondary maximum is formed by the 25—29 cm. group and in one instance the curve has a greater range and neither of the two secondary maxima appear.

On the basis of this cruise a definite relation between the length distribution and depth or temperature was not revealed, but this matter requires a further study. At any rate, it seems clear that various size groups of redfish exist in separate shoals.

A general picture of the length distribution based on all the material from the cruise is shown in Figure 76. Obviously, a maximum is found at the 35—39 cm. length group, and a secondary maximum at the 50—54 cm. group. Between these two maxima, at 45 cm., a minimum is indicated which becomes quite distinct, if 3 cm. length groups are used. Possibly, a clearer picture of the length distribution of redfish in general would be obtained, if the 3 cm. length groups were used instead of 5 cm. It should here be remarked, however, that measurements of redfish landed from the Anton Dohrn Bank, where great quantities were taken, reveal an entirely different length distribution, as a maximum was found at 45 cm. (Fig. 77).

Cruises 2—3

The cruises with the S/T "Harðbakur" were made from 1.—13. June and 4.—13. September. On both cruises the area from about 63°50'N., 10°50'W. to 67°10'N., 22°00'W. was surveyed.

In June, 3 samples of redfish were taken in two different areas, a total of 1111 measurements.

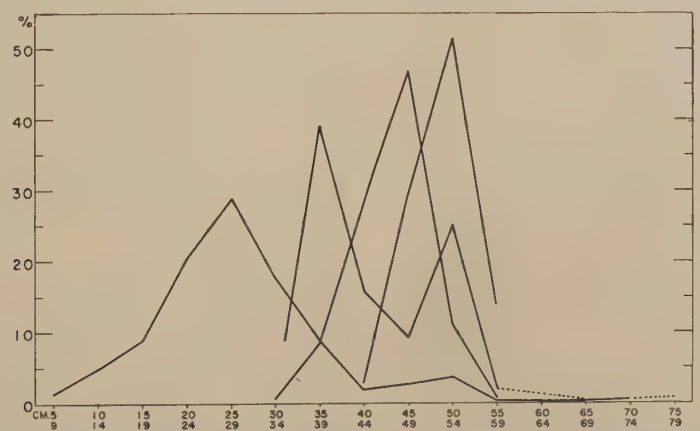


Figure 75. Length distribution of redfish in different hauls from the East Greenland banks. The curves here, and also in the following diagrams, are based on the relative number of fish in each 5 cm. group.

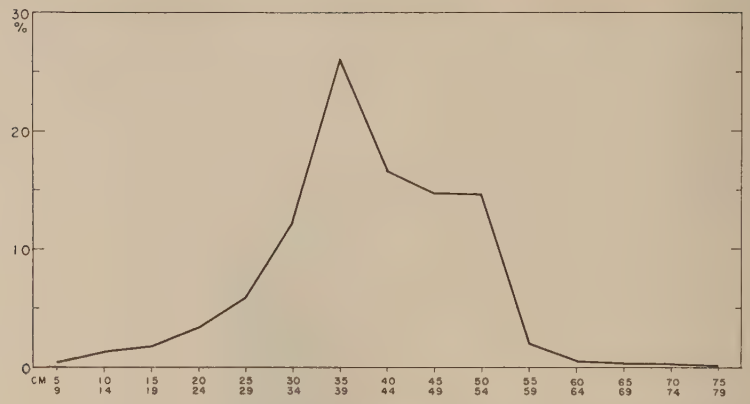


Figure 76. Length distribution of all redfish measured on the East Greenland banks.

In September, however, 21 samples were taken at 15 different localities, a total of 3643 measurements. In general, catches of redfish were poor and mainly cod was caught. The length distribution at both cruises was found to be almost indentical, so that the results from both cruises will here be considered jointly.

As regards the material the separation of the length groups appeared even still more distinctly than in the material collected on the East Greenland banks. Most of the trawling stations were situated near the 200 metre contour (Fig. 78). As was found during the cruise with the M/T "Jón Thorláksson" a relation between size of fish and temperature or depth was not found. However, certain size groups are characteristic of different areas. In this way the whole region investigated may be divided into 5 sub-areas (Fig. 78). It should here be remarked that only one sample was taken in the areas A and B whereas the samples taken from areas C—E totalled 5, 14, and 3 respectively (Fig. 78). The length distribution from the respective areas was found to be so characteristic that practically the same result was obtained whether the length distribution was determined from the total individuals measured for the area in question or from measurements of one haul only. Area D formed the only exception as the length distribution of the haul taken in the westernmost part of the area resembled that of area C. As appears clearly from Figure 79 the length of the redfish decreased from area E to C. In areas A and B, however, where hydrographic conditions are different, the size was much greater.

A general picture of the length distribution based on all material from cruises 2—3 is given in Figure 80. Three distinct maxima are apparent, one formed by the 30—34 cm. group being the largest, whereas in the case of cruise 1 the largest maximum was formed by the 35—39 cm. group. However, one of the two secondary maxima in

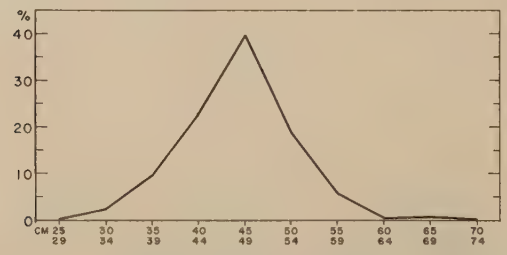


Figure 77. Length distribution of redfish landed from the Anton Dohrn Bank.

Figure 78. Chart showing the localities of sampling with the S/T "Harðbakur" and the division into sub-areas.

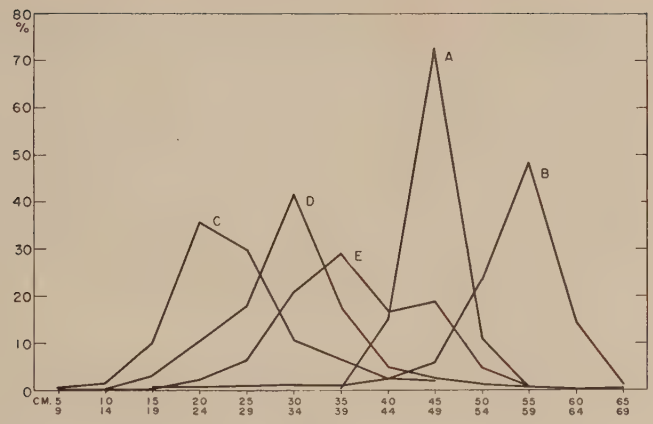


Figure 79. Length distribution of redfish in the different sub-areas (A—E) showed in Figure 78.

Figure 80 (cruises 2—3) coincides with the maximum shown in Figure 77 (Anton Dohrn Bank) and the minimum in Figure 76 (cruise 1). The length distribution in cruises 2—3 was clearly different from that of cruise 1. Although this may be caused by many factors the observed difference in this case was no doubt due to the fact that the cruises with the S/T "Harðbakur" and the M/T "Jón Thorláksson" covered different areas.

Discussion

At this stage it cannot be known with certainty whether the individual curves shown in Figure 79 indicate a definite year-class. The length distribution of small redfish collected in 1953 and specially selected, has been published by FRIÐRIKSSON[1]). He found a distinct maximum at 16 cm. and suggests that this maximum, if not due to selection, may indicate a distinct year-class. During the cruise with the M/T "Jón Thorláksson" small redfish was also selected from the hauls and measured as in 1953. The individuals selected in this way totalled 1183, but they were not included in the general material. As appears clearly from Figure 81 the length distribution of the small redfish showed a maximum formed by the 25—29 cm. length group (at 27 cm.). A glance at Figure 76 will show that the length curve rises rather abruptly after the 25—29 cm. group is reached. The maximum formed by the small redfish from the selected sample is therefore undoubtedly the result of the selection made. The result of the 1955 length measurements therefore seems to support FRIÐRIKSSON's view, especially when it is remembered that the material was collected both in 1953 and 1955, by the same person and in the same way.

[1]) Ann. Biol., Vol. X.

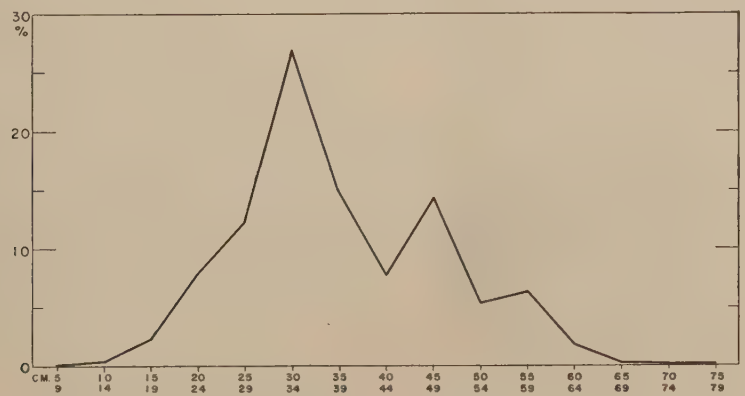


Figure 80. Length distribution of all redfish measured during the cruises with the S/T "Harðbakur".

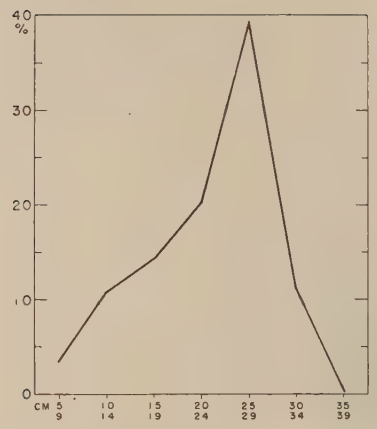


Figure 81. Length distribution of small redfish collected on the M/T "Jón Thorláksson" cruise.

Unfortunately, no similar selection of small redfish was made during 1954, so that the 15—19 cm. group (from 1953) could not be followed from year to year. On the assumption that the 15—19 cm. group represents a distinct year-class, and further that this year-class, viz. the 30—34 cm. group, forms the main maximum found during the cruises with the S/T "Harðbakur", the 15—19 cm. group would represent age-group I and the 30—34 cm. group age-group III in KOTTHAUS' age analyses[1]). Looking at Figure 79 we see that the 30—34 cm. group forms the maximum in curve D, which would then represent age-group III. The maximum in curve C and the main maximum in curve E would then also represent definite year-classes, viz., age-groups II and IV. If our assumptions are correct the result would be that the redfish caught during the cruise with the "Jón Thorláksson" consisted mainly of 4-year-old fish and the redfish caught during the cruises with "Harðbakur" of 3-year-old fish.

JAKOB MAGNÚSSON

[1]) Ber. Deutsch. wiss. Komm. f. Meeresforsch., N.F., Bd. XII, H. 4. 1952.

Redfish caught by Scottish Research Vessels

Although no detailed work has yet been carried out from Aberdeen on *Sebastes*, all redfish caught by Scottish research vessels are counted and measured. In view of the problems met in redfish investigations on both sides of the Atlantic, it is felt that these data should be made available to the small group of workers concerned. The records from Faroe and Iceland are tabulated in Tables 7 and 8 respectively.

Faroe (Table 7)

Records from this area relate mostly to the cruises of "Scotia" for the period 1949—1953. Some data are also available from "Explorer" between 1931 and 1947. The hauls were made in depths varying from 75 to 175 m. on the Faroe Plateau and Faroe Bank. The data do not show any significant differences in numbers or sizes of fish caught at the various stations. In any one month there is often only one mode — at or around 18 cm. When other modes occur, they are usually between six and eight centimetres or between ten and twelve centimetres, while a higher mode is sometimes evident at twenty-seven centimetres. It is of interest that in more than 250 hauls over these years, 99.3% of the fish lie within the size range 6—28 cm. Large redfish do occur at Faroe but in considerably deeper water. MEYER[1]) gives measurements between 25 and 60 cm. of redfish caught by German trawlers in 300—400 m. depth off north and east Faroe.

Iceland (Table 8)

The records from Iceland were collected from one cruise by "Explorer" in summer 1925 and four cruises by "Scotia" from June to September 1950—53. The hauls were mostly along the coast of south Iceland, chiefly in the south-west corner in depths between 100 and 140 m. The data show two very obvious modes — one about 22 cm. and the other about 43 cm. The larger specimens here are certainly *S. marinus*, and if there is any truth in the idea that *marinus* and *viviparus* are not found together, then the whole population may be *S. marinus*. It is interesting that this type of distribution — two clear peaks with a gap of five or six centimetres between — has been noted for other areas.

A. D. MCINTYRE

[1]) Ann. Biol., Vol. XI (1954) 1956, p. 28.

Table 7. Length Frequencies of Redfish caught by Scottish Research Vessels at Faroe

Date	No. of hauls	Length in cm. 5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	>30	No. of fish
1931 May	10	—	—	1	—	2	2	5	4	3	2	7	8	5	7	11	11	8	8	6	7	2	1	—	1	—	—	—	101
1933 June	5	3	7	—	—	—	6	8	15	11	13	18	29	27	31	25	20	20	5	—	—	1	3	—	—	—	—	—	242
1935 June	7	—	—	—	—	2	6	6	13	8	3	10	15	26	22	22	9	4	1	1	2	—	—	—	—	—	—	—	150
1936 June	9	—	—	—	2	6	4	10	25	24	27	19	13	18	16	9	5	3	—	1	1	2	1	—	—	—	—	—	184
1937 May	6	—	—	—	—	1	5	19	26	22	14	11	20	16	27	39	31	22	16	14	7	1	4	6	4	2	1	2	310
1938 July	3	—	—	—	—	—	—	1	—	—	—	6	14	12	9	12	11	5	1	2	—	—	—	—	—	—	—	—	—	73
1939 June	12	—	1	—	—	—	—	—	—	5	31	71	112	148	115	78	59	35	35	33	13	11	3	3	4	—	—	—	757
1947 June	8	—	—	—	—	—	—	—	1	5	10	18	10	18	27	35	28	31	20	15	15	12	7	7	3	1	1	—	264
1949 May	3	—	—	—	—	—	—	—	—	—	—	—	1	1	10	9	8	6	7	4	2	—	1	—	—	—	—	—	49
1949 July	6	—	—	—	1	—	—	2	2	4	10	12	8	17	38	42	38	22	20	15	13	5	2	—	—	—	—	—	251
1949 Sept.	5	—	—	—	—	—	2	4	6	5	11	7	23	16	19	27	18	15	9	6	4	—	5	—	—	—	—	—	177
1950 March	3	—	—	—	—	—	—	—	—	2	1	5	2	3	10	16	7	7	7	6	—	2	1	1	2	—	—	—	72
1950 April	11	1	1	—	1	1	2	1	—	2	2	4	1	3	3	2	3	3	1	3	—	—	—	2	1	1	—	—	38
1950 May	11	1	—	—	1	—	—	1	1	2	11	21	21	18	24	19	16	11	7	7	2	6	1	2	—	—	—	—	172
1950 June	12	1	7	2	1	2	3	3	9	8	2	9	5	5	10	7	7	2	4	3	1	—	1	—	—	—	—	1	93
1950 July	13	—	6	2	—	—	3	5	10	13	24	16	27	43	44	42	22	27	13	16	17	2	5	6	3	3	1	4	354
1950 Sept.	2	—	—	—	—	—	—	—	—	3	2	5	4	5	9	12	11	9	5	2	2	—	—	—	—	—	—	—	69
1950 Oct.	6	—	—	—	—	—	—	—	—	—	—	1	11	6	6	14	10	8	3	—	1	1	—	—	—	—	—	—	61
1951 April	7	—	—	2	1	—	—	1	2	1	5	2	1	5	7	6	6	2	3	2	3	2	—	—	—	1	—	—	52
1951 May	18	1	—	1	5	—	1	—	5	2	12	8	12	19	15	16	14	4	2	5	2	2	2	2	1	—	—	—	131
1951 Sept.	12	—	—	—	3	3	9	5	—	2	3	5	14	7	15	20	20	7	9	5	8	2	2	5	2	1	—	—	147
1951 Oct.	5	—	—	—	—	—	—	1	1	1	7	5	10	11	11	11	17	14	13	5	4	2	1	6	2	—	—	—	122
1952 Feb.	8	—	—	—	1	2	1	1	1	—	4	7	4	8	11	15	8	8	9	5	2	2	—	—	—	—	—	1	90
1952 March	8	—	—	—	—	1	—	2	—	2	3	1	2	2	6	5	2	—	—	—	—	1	—	—	—	—	—	—	27
1952 June	18	—	2	20	6	14	6	5	7	4	15	13	16	18	20	15	10	9	4	7	6	—	2	2	1	—	—	3	205
1952 July	16	—	—	—	—	—	—	—	1	2	1	1	9	26	39	28	24	10	13	7	5	1	—	—	1	—	—	—	168
1952 Nov.	13	—	—	—	—	—	1	3	5	12	7	7	8	14	10	11	6	4	3	2	4	1	1	1	—	—	—	—	100
1953 Feb.	9	—	—	1	1	—	2	—	1	1	—	—	1	4	7	7	9	6	6	3	1	1	—	—	2	—	—	—	53
1953 May	3	—	—	—	—	2	9	15	8	7	12	12	17	16	22	15	13	5	3	10	5	2	1	—	1	—	—	—	175
1953 June	5	—	—	—	—	—	2	1	3	3	5	8	18	27	42	16	13	16	9	8	4	3	5	2	—	—	—	—	185

Table 8. Length Frequencies of Redfish caught by Scottish Research Vessels at Iceland

Date	No. of hauls	Length in cm. 5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1925 June/July	21	—	—	—	1	2	—	—	—	—	1	—	1	2	6	—	—	5	2	—	3	2	3	3	1	1	1	1	4
1950 Sept.	9	—	—	—	—	—	3	1	—	3	1	—	1	—	1	2	6	5	2	5	5	1	2	1	2	1	1	2	1
1951 Aug.	11	—	—	—	—	—	—	7	15	11	2	7	6	5	8	11	22	40	39	21	29	18	7	8	5	—	2	1	1
1952 Sept.	10	—	2	—	1	—	1	—	—	4	6	11	6	5	12	25	32	27	40	35	22	11	10	10	5	5	3	1	1
1953 June	3	—	—	—	—	—	—	—	—	—	—	1	—	2	2	3	6	5	2	1	1	1	2	—	2	—	—	—	—

Date	No. of hauls	Length in cm. 33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	>54	Total No. of fish
1925 June/July	21	6	6	22	36	31	49	72	70	89	92	81	84	75	68	56	26	24	4	3	1	3	1	1/60	939
1950 Sept.	9	—	1	3	3	7	1	15	21	30	34	41	38	37	29	19	14	10	4	1	1	—	—	—	355
1951 Aug.	11	1	2	3	4	5	6	14	15	17	32	24	30	21	23	14	4	3	2	—	2	—	—	—	487
1952 Sept.	10	1	—	1	1	3	2	5	8	9	7	16	11	18	14	18	13	5	3	1	—	—	—	—	411
1953 June	3	1	1	2	2	2	9	11	20	11	8	9	7	4	6	5	4	2	—	—	—	—	—	—	132

Rare Fishes from Distant Northern Seas

Germany

In 1955 the "Institut für Meeresforschung"-Bremerhaven (IFM), the "Abteilung Fischereibiologie der Biologischen Anstalt Helgoland"-Bremerhaven (BAH) and the "Institut für Seefischerei der Bundesforschungsanstalt für Fischerei"-Hamburg (IS) received only a few remarkable or rare fishes caught by commercial fishing vessels in the above area. A number of species, however, were collected on two cruises of the newly built German R/V "Anton Dohrn" in Icelandic and Greenland waters. Of these species, the total of which will be listed elsewhere, we are dealing here only with those considered "exotics" or having their northern boundary in that area. Finally some material collected by Dr. EINARSSON, Reykjavik, in 1954/55 and sent to Dr. KREFFT for determination is included.

The small number of records in 1955 from the "Rosengarten" is striking. A hydrographic survey of the Iceland-Faroe Ridge in the beginning of July ("Anton Dohrn") shows that the "Rosengarten" is overflown by the cold waters of the Norwegian Sea. The commercial redfish catches from that ground are said to have been poor too. Therefore it seems likely that the bathypelagic fauna of the "warm" Atlantic water did not migrate into the "Rosengarten" area this year.

If not otherwise stated, IFM (Dr. BRANDES), BAH (Dr. KOTTHAUS), and IS (Dr. KREFFT) are responsible for the determination of the following species.

1. *Anotopterus pharao* ZUGMAYER 1911
   23.9.55, 61°46′N.—50°38′W., 200 m. depth, 1 (only head) from stomach of *Gadus callarias* (IS)

2. *Aphanopus schmidti* SAEMUNDSSON 1907
   26.5.55, "Rosengarten", 1 ♀, 107 cm. (IS)
   27.5.55, "Rosengarten", 300—400 m., 1, 103.5 cm. (IS)

3. *Argyropelecus hemigymnus* COCCO 1829[1])
   27.8.54, 64°51′N.—35°04′W., 370—390 m., 1, 3 cm., from stomach of *Sebastes* (Dr. EINARSSON; KREFFT det.)

4. *Bathylagus benedicti* GOODE & BEAN 1895
   23.9.55, 61°46′N.—50°38′W., 200 m., 1, 17 cm., from stomach of *Gadus callarias* (IS)

5. *Beryx decadactylus* CUV. & VAL. 1829
   12.—14.1.55, "Rosengarten", southern part, 1, 54 cm. (BAH)
   17.4.55, 63°28′N.—25°40′W., 1, 49 cm. (IFM)

6. *Centroscymnus coelolepis* BOCAGE & CAPELLO 1864
   26.6.55, 63°33′N.—25°51′W., 470—500 m., 1 ♀, 81 cm., 3 ♂♂, 49, 52, 53 cm. (BAH)
   7.7.55, "Rosengarten", 1 ♀, 110 cm. (IFM)

7. *Ceratias holboelli* KRØYER 1844
   28.1.55, 63°20′N.25°10′W.—63°23′N.25°15′W., 350 m., 1 ♀, 98 cm. (BAH)
   7.3.55, Westman Isl., 1 ♀, 64 cm. (IFM)

8. *Chauliodus sloanei sloanei* SCHNEIDER 1801
   1.6.55, 60°13′N., 25°W.—60°11′N., 25°30′W., 400 m., 2, 150 and 157 mm. (BAH)
   11.6.55, 63°56′N.—36°56′W., 320—350 m., 1, from stomach of *Sebastes*? (BAH)
   28.6.55, 66°02′N., 26°38′W.—66°03′N., 26°40′W.,[1]) 1 (BAH)

9. *Chiasmodon niger* JOHNSON 1863[1])
   January 1955, abt. 65°N.—35°W., 1, 127 mm. (Dr. EINARSSON; KREFFT det.)

10. *Coelorhynchus coelorhynchus* (RISSO 1826)[1])
    11.6.55, 63°55′N.—36°55′W., 420—430 m., 1, 18 cm. (BAH)

11. *Cryptopsaras couesi* GILL 1883
    1.6.55, 60°13′N., 25°W.—60°11′N., 25°30′W., 400 m., 1, 166 mm. (BAH)

12. *Cyclothone braueri* JESPERSEN & TÅNING 1926
    27.8.54, abt. 64°51′N.—35°04′W., 370—390 m., 18, from stomachs of *Sebastes* and *Argentina* (Dr. EINARSSON; KREFFT det.)

13. *Lepidion eques* (GÜNTHER 1887)
    17.6.55, 62°41′N., 23°45′W.—63°09′N., 23°56′W., 450 m., 1, 17 cm. (BAH)
    26.6.55, 63°55′N.—25°51′W., 470—500 m., 1, 21 cm. (BAH)
    27.6.55, 64°40′N., 27°12′W.—64°42′N., 27°17′W., abt. 450 m., 7, 15—29 cm. (BAH)

14. *Melamphaes* (*Scopelogadus*)? spec.[1])
    January 1955, abt. 65°N.—35°W., 1, 65 mm. (badly preserved, not identifiable) (Dr. EINARSSON; KREFFT det.)

15. *Myctophum* (*M.*) *punctatum* RAFINESQUE 1810[1])
    23.9.55, 61°46′N.—50°38′W., 200 m., 5, from stomachs of *G. callarias* and *Sebastes marinus* (IS)

16. *Notacanthus phasgonorus* GOODE 1881
    16.5.55, "Rosengarten", 1, 96.5 cm. (IS)
    26.6.55, 63°33.5′N.—25°51′W., 470—500 m., 1 (BAH)
    Two specimens of *Notacanthus* not exactly identified were mentioned from 29.9.55, 66°38′N.—55°09′W., 635 m. depth (IS)

17. *Notoscopelus elongatus* (COSTA 1844)
    11.6.55, 63°56′N.—36°56′W., 320—350 m., 10, from stomach of *Sebastes*? (BAH; KREFFT det.)
    14.9.55, 65°42′N.—29°36′W., 365 m., 2, from stomachs of *G. callarias* and *Pollachius virens* (IS)
    15.9.55, 65°30′N.—30°40′W., 375 m., 2, from stomachs of Gadidae (IS)
    23.9.55, 61°46′N.—50°38′W., 200 m., 4, from stomach of *G. callarias* (IS)

18. *Notosudis lepida* KREFFT & MAUL 1956[2])
    January 1955, abt. 65°N.—35°W., 1, 127 mm. (Dr. EINARSSON coll.)

19. *Paralepis coregonoides borealis* REINHARDT 1838
    11.6.55, 63°56′N.—36°56′W., 320—350 m., 2, 28+27 cm. and 3 not measured, from stomachs of *Sebastes*? (BAH; KREFFT det.)

[1]) First or northernmost record in the area.

[2])Holotype, description of this new species in Archiv f. Fischereiwissenschaft, **6**, 5/6, 1956.

14.9.55, 65°42′N.—29°36′W., 365 m., 1, 27 cm., from stomach of *P. virens* (IS)

23.9.55, 61°46′N.—50°38′W., 200 m., 1, from stomach of *Sebastes* (IS)

20. *Paralepis brevis* Zugmayer 1911

14.9.55, 65°42′N.—29°36′W., 365 m., 1, ad. (only head and pectoral region) from stomach of *P. virens* (IS)

23.9.55, 61°46′N.—50°38′W., 200 m., 1, 40 cm., from stomach of *Sebastes* (IS)

21. *Searsia schnakenbecki* Krefft 1953[1])

October 1954, 64°51′N.—35°04′W., 370—390 m., 1, 12.5 cm. (Dr. Einarsson coll.; Krefft det.)

14.9.55, 65°42′N.—29°36′W., 365 m., 1, ad.(without head) from stomach of *Gadus callarias* (IS)

22. *Serrivomer beani* Gill & Ryder 1883[3])

October 1954, 64°51′N.—35°04′W., 370—390 m., 1, 37 cm. (Dr. Einarsson coll.; Krefft det.)

January 1955, abt. 65°N.—35°W., 390 m., 1, 43 cm. (Dr. Einarsson coll.; Krefft det.)

1.6.55, 60°13′N., 25°W.—60°11′N., 25°30′W., 400 m., 1, 32 cm. (BAH; Krefft det.)

15.9.55, 65°30′N.—30°40′W., 375 m., 2 (only heads) from stomach of *G. callarias* (IS)

23. *Stomias boa ferox* Reinhardt 1842

27.8.54, 64°51′N.—35°04′W., 370—390 m., 16 (Dr. Einarsson coll.; Krefft det.)

29.8.54, 64°51′N.—35°04′W., 370—390 m., 10 (Dr. Einarsson coll.; Krefft det.)

all from stomachs of *Sebastes*

1.6.55, 60°13′N., 25°W.—60°11′N., 25°30′W., 400 m., 21, 72—210 mm. (BAH)

24. *Xenodermichthys copei* (Gill 1884)[1])

17.6.55, 62°41′N., 23°56′W.—63°09′N., 23°45′W., 450 m., 1 (BAH)

C. H. Brandes, A. Kotthaus, G. Krefft

[3]) Mme Bauchot-Boutin (Musée National d'Histoire Naturelle, Paris) kindly verified the determination of the *Serrivomer* specimens. She identified tentatively one of the two heads of 15. September as that of a *S. parabeani* Bertin 1940.

Scotland

The following rare fishes were landed at Aberdeen by commercial vessels from north-western grounds during 1954 and 1955.

1954

Raia lintea, Fries. Stated by Saemundsson to be rare off the south coast of Iceland, four specimens were landed by an Aberdeen liner from the Loon Deeps in September.

Lampris guttatus (Brünnich). One fish trawled 14′S.S.E. of Fuglø, Faroe, in August.

Lycodes esmarkii (Collett). One specimen of 54.5 cm. by great line from the Vikural grounds, N.W. Iceland, in May.

1955

Cetorhinus maximus (Gunner). Two young specimens of 3.66 and 2.90 metres trawled on northern Faroese grounds on 17. June and 7. July.

Centroscyllium fabricii (Reinhardt)
Centroscymnus coelolepis Bocage and Capello
Scymnodon jonsonii (Jensen)
Centrophorus squamosus (Gmelin)

One specimen of each of these species was caught by the research vessel "Scotia" while fishing with great lines at 63°00′N., 25°10′W. on 2. May.

Trachypterus arcticus (Brünnich). One fish, 175 cm. long, trawled 10/12′N.W. of Myggenaes, Faroe, on 20. November.

Lycodes esmarkii (Collett). One fish, 68 cm., trawled off South Iceland, 26. July.

B. B. Rae, E. Wilson

Near Northern Seas

INTRODUCTION

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A. Environment

The hydrographic observations in the northern Irish Sea in the autumn of 1955 show a northward movement of Irish Sea water in the upper layers of the North Channel and on the east, and a southerly flow in the deep layers and to the west. The Atlantic influence was relatively weak north and west of the Butt of Lewis.

The Scottish drift-bottle liberations have been increased during 1955 and the results of the surface drift-bottles indicate an increasing strength of the Atlantic Current in the Faroe-Shetland Channel in the autumn of 1955 with a maximum in November, a waning the next two or three months and a waxing again in March 1956. The oceanic incursion into the northern North Sea between Shetland and Norway showed its maximum intensity and penetration in December 1955. The spring—summer returns of 1955 suggested a relatively quiescent surface water circulation in the northern North Sea in these months.

The Scottish hydrographic surveys in the northern North Sea indicate that the conditions were much less oceanic than in 1954, and the temperature pattern has not been dominated by inflowing Atlantic water.

The report on the chemical observations which is the last in this series shows that the incursion of oceanic water, rich in nutrients, at the end of 1954 and beginning of 1955 restored the phosphate winter maximum within the North Sea to the 1952 and 1953 levels. 1955 seems, indeed, to have been richer in winter phosphate than the previous three years. The early summer values show a remarkable similarity to those of 1953, the phytoplankton, however, being more vigorous in 1955 than in 1953. In late summer large areas west of 3°E. showed almost total exhaustion of phosphate which coincides with the fact that the oceanic influence appeared to be nil in July 1955. The 1955 results confirm the earlier results of four main zones of phytoplankton activity in the North Sea.

The German hydrographical sections of the central and northern North Sea show also great similarities to 1953 in the summer stratification. The temperatures in the two cold bottom water centres are unusually low and it may be explained as an after-effect of the very cold spring of 1955.

The Danish observations from the southern North Sea and especially from the Bløden Ground area confirm these results both concerning the cold spring water and the summer stratification. In the stratified water the turbulence-free layer was observed between 10 m. and 20 m. frequently of a width of less than 2 m.

In the southern North Sea a fifth relatively cold water body was observed in March 1955 on the Dogger Bank in addition to the four main water masses observed in preceding years. The cross circulation between the coastal and the North Sea water in the residual currents has been studied. In the residual current near the bottom there is nearly always a component directed towards the coast, while near the surface seaward-directed movements prevail.

The German lightship observations also show extraordinarily low annual means for the surface salinity in the German Bight in 1955 compared with the means for 1950/54. The surface temperatures also were relatively low from January to June. At the Danish lightvessel "Vyl" a negative deviation was observed, from March to June, at the surface, and between March and August a very pronounced negative deviation in the bottom water with a steady increase in the deviation up to August.

In the Kattegat the Danish and Swedish observations showed surface temperatures below normal during the first six months of the year and a strongly developed thermocline in July—September. The salinity was also below normal during the four first months of 1955 but May showed unusually high values due to strong westerly winds.

The phytoplankton distribution during the spring and early summer was similar to that of 1954 but differed in late summer and autumn corresponding to the greater oceanic influence in 1955.

As appears from the Scottish investigations there were three dominant features in the zooplankton which had definite and immediate effects on the fisheries. Great concentrations of *Oikopleura* in May off the east Scottish coast formed the major food of the haddock feeding in the area at that time. A rich *Calanus* community in spring and early summer caused the herring to be too fat for good curing. An exceptionally dense salp invasion entered the North Sea mostly north of Shetland in the autumn and produced conditions unfavourable to the herring. Moreover *Cyanea* was particularly abundant in the north-west of the area the more so as it made the handling of the herring difficult; it might, however, have had some beneficial effects on the survival of some post larval gadoids such as whiting.

In the Continuous Plankton Recorder Survey the species or groups of species used in the summaries for the past seven years were extremely scarce in 1955. For the zooplankton as a whole 1955 was a very poor year. The averages for "total copepods" were generally lower than in 1954, which was previously the poorest year since the observations began. Among the indicator species only *Thaliacea* were well represented during 1955.

B. The Fish

Eggs and Larvae. German investigations in the southern North Sea showed that the cold spring delayed the spawning of whiting and sprat. In the central North Sea and down to the German Bight the plaice spawning was very intensive during the latter half of February. Cod eggs were present in numbers unprecedented in the southern North Sea. Dab eggs were also plentiful along the west and north Friesian coasts.

Plaice. A comparison between 6 different year-classes in three different stages, both from Denmark and England, shows a certain similarity in the relative strength of the year-classes. In the Danish Waddensea the investigations gave a number/hour below average of both the O- and the I-group. Off Esbjerg the 1953 year-class dominated, as could be expected from the results of the 1954 investigations. At Esbjerg the 1952 year-class dominated in the landings from the eastern and southern North Sea, and the 1947 year-class, seconded by the 1950-class, in those from the Dogger Bank and the northern North Sea. In the central and northern Kattegat the 1955 year-class was less plentiful than usual. In the southern Kattegat it was much stronger than normal at the Danish coasts, but less than normal at the Swedish coast. The total stock in the northern Kattegat was similar to that of previous years and much weaker than in the '30ies. The commercial catches in the Kattegat were dominated by the rich 1952 year-class, but this year-class must now be greatly reduced and the yield must be expected to decline. The Danish transplantatations of plaice to the Limfjord were continued.

Flounder. In the central Kattegat the 1955 year-class was much stronger than normal.

Dab. A comparison between the stocks in the southern North Sea and at the North Friesian coast shows no marked differences in the age composition. The growth-rate is somewhat higher in the southern North Sea than in the coastal area.

Turbot and Brill. In Kattegat the O-group was above normal in 1955.

Sole. Market measurements in England show a rapid decline, after 1946, in the war-time accumulation of large fish and a remarkable influx of small soles, mainly the 1947 year-class, in 1949—50. At all Danish coasts of the Kattegat the O-group was much above normal.

Eel. The tumour disease in Danish waters was somewhat less frequent than in 1954.

Sand-eel. A Danish investigation of the sand-eel fishery has been started because the catch in 1955 (34 mill. kg.) was more than seven times that of 1953.

Whiting. In the English market measurements the evident decline of the smaller whitings is probably due to the use of larger meshes and the raising of the minimum size above 20 cm.

J. Hult

ENVIRONMENT

Hydrography

Near Northern Seas and Approaches

General

The extent of Scottish hydrographic operations in 1955 by the several vessels enumerated, working mainly in the northern North Sea and Faroe-Shetland Channel, but including also north-eastern Atlantic and Icelandic waters, is given in Table 1.

Only the drift-bottle liberations and their results show an apparent increase in activity during 1955 compared with 1954[1]), but the diminution in other respects is almost entirely to be accounted for by the restrictive effects of severe weather in the early months of 1955.

Details of the surface drift-bottle recoveries from liberations in 1955 are given in Table 2.

The total drift-bottle return from all liberations in 1955, at 18%, is considerably greater than the result of the previous year (14½%). From the Weather Ships alone, however, the return of 9½% compares with the corresponding ratio of almost 14% in 1954. There were no French or south-west English coast returns from the 1955 Weather Ships' liberations, the bulk of the recoveries from which took place on the west Irish coast (from Weather Station "J"), and on west Scottish coast (from both stations). An appreciable number of the returns from these liberations, however, came from the Norwegian coast, outwith the North Sea, and at least three drifters coursed into the North Sea to strand in the Skagerak and on the North Sea Norwegian coast-line. The latter category of strandings was still more pronounced in respect of liberations from the Scottish research ships in the Faroe-Shetland Channel and N.E. Atlantic Ocean regions in 1955, the total return from which at 17½% showed a considerable excess over the corresponding ratio for 1954 (13½%). Indeed, these eastern North Sea seaboard and higher latitude Norwegian recoveries, as broad indicators of the waxing and waning strength of the Atlantic Current in the Faroe-Shetland Channel and its partial incursion into the northern North Sea, merit closer study.

Maximum higher latitude Norwegian coast recoveries occurred in the months of November 1955 and March 1956; and one of the two North Sea Norwegian coast recoveries from Weather Ships' liberations took place also in November 1955, the other on the last day of February 1956. Further, the only Weather Ships'Skagerak return occurred in March 1956.

Now, northern Norwegian coast recoveries from Faroe-Shetland Channel and N.E. Atlantic Ocean

[1]) See Ann. Biol., XI (1954), p. 33, Table 1.

Table 1. Scottish Hydrographic Operations, 1955

Vessel	Hydrographic stations	Temp. observations	Salinity observations	Oxygen observations	Phosphate Free	Phosphate Total	Drift-Bottles Liberations	Drift-Bottles Recoveries
"Scotia"	433	2732	2673	576	773	31	730	414
"Explorer"	537	2807	2841	997	1656	—	1200	
"Clupea"	402	1248	1110	27	546	—	—	—
"Kathleen"	18	24	24	—	—	—	—	—
Weather Ships ..	—	—	—	—	—	—	740	71
Totals	1390	6811	6648	1600	2975	31	2670	485

Table 2. Drift-Bottles at Weather Stations "J" (A) and "I" (B), in the Faroe-Shetland Channel and N.E. Atlantic Ocean (C), and in the North Sea (D), 1955

	Liberations No. of Drifters	Recoveries Frequency-Distribution[1]) 0[1]	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Totals
A	270	—	11	6	5	—	—	—	—	—	—	—	—	—	2	1	—	—	—	—	25
B	470	—	3	8	13	3	—	—	—	—	—	—	—	1	—	14	2	—	—	2	46
C	420	—	—	—	14	6	1	—	—	—	—	1	3	12	12	24	—	—	—	—	73
D	1510	—	—	—	2	—	—	2	—	—	—	21	32	139	55	84	3	3	—	—	341

[1]) For definition of the column numbers in this table see footnote p. 94 of Ann. Biol., VIII (1951).

liberations reached a conspicuous maximum in October 1955 and after declination to nullity in February 1956 recurred in the following month. In the intervening months between October-November 1955 and March 1956, not only did North Sea Norwegian coast returns reach a maximum figure in December 1955, and Skagerak returns in January 1956, but west Danish and even Schleswig-Holstein coasts recoveries began to appear in the month of December from these extra-North Sea liberations.

The latter somewhat more significant returns, from the point of view of oceanic incursion into the North Sea, are very prominent in the records of North Sea liberations from March to September 1955 inclusive. High maximum Schleswig-Holstein, west Danish, Skagerak, and North Sea Norwegian coasts recoveries took place during December 1955 and after significant numerical declination in the two following months, re-appeared in March 1956, except in the case of Schleswig-Holstein coast returns.

These and contributory factors in the surface drift-bottle records for 1955 indicate increasing strength of the Atlantic Current in the Faroe-Shetland Channel in the autumn of 1955 to maximum intensity in November, waning thereafter in this region over the next two to three months, and waxing again in March 1956. In the interval the oceanic incursion into the northern North Sea between Shetland and Norway appears to have increased in strength to maximum intensity and penetration in the last month of 1955, with indication of minor resurgence in March 1956 after declination in the intervening two months.

Returns during the spring–summer months of 1955 from almost all regions were small in comparison with previous years, suggesting a relatively quiescent surface water circulation in the northern North Sea and no marked power behind the oceanic influx in these months. This, it may be recalled from last year's report, was probably at a maximum in the first month of the year after which declination probably set in. The lack of open-sea hydrographic observations for the early part of the year precludes the assessment of conditions in that period, but a temperature-salinity survey of the eastern region of the Faroe-Shetland Channel in the latter half of March 1955, together with a cross-section of the Channel one month later, indicate at least a fairly strong flow of the Atlantic Current in these months.

J. B. Tait

Hydrographic Observations off the Scottish West Coast and the Northern Irish Sea, Autumn 1955

(Figures 1–4)

In Vol. XI, pp. 34—36 of this journal, charts are presented showing temperature and salinity in this region in autumn 1954. In the latter part of 1955 further observations were made jointly by the Scottish Home Department and the Marine Biological Station, Port Erin (University of Liverpool).

Figure 1 shows conditions in October in the region of the Minches. In the northern part of this area temperatures are about 1°C. higher than in 1954. In the southern part, they are about the same as in 1954.

The survey does not cover the region of oceanic inflow to the South Minch; hence it is not possible to compare the conditions there with previous years. However, in the Central Minch, D.C.I. values are about the same as last year. For an explanation of the term D.C.I. see Vol. X, pp. 86—89 of this journal.

In the region north and west of the Butt of Lewis, D.C.I. values are unusually high, i. e., salinities are low and, coupled with the temperature distribution, suggest that Atlantic influence was relatively weak in this region.

Figure 2 shows conditions in a region from the North Channel to the Isle of Man in October—November. In Figure 3 are shown also the conditions at the same time, in the form of four hydrographic sections across the North Channel. Temperatures are unusually high, perhaps $\frac{1}{2}$°C. to 1°C. above normal, and salinities are also unusually high. The D.C.I. value is about 0.1 lower than 1953 and 0.2 lower than 1954.

The general impression is of northward movement of Irish Sea water in the upper layers of the North Channel, and on the east. There is indication of southerly flow in the deep layers and to the west. The Firth of Clyde appears to be rather isolated, as there was a very abrupt temperature transition corresponding roughly to the 30 fathom line across the mouth of the Firth.

Later in the year, in November-December (see Figure 4), there is indication of North Channel water flowing over the ridge at the mouth of the Firth of Clyde, and beginning to fill the Clyde basin which earlier had been cold and relatively stagnant.

R. E. Craig
D. J. Slinn

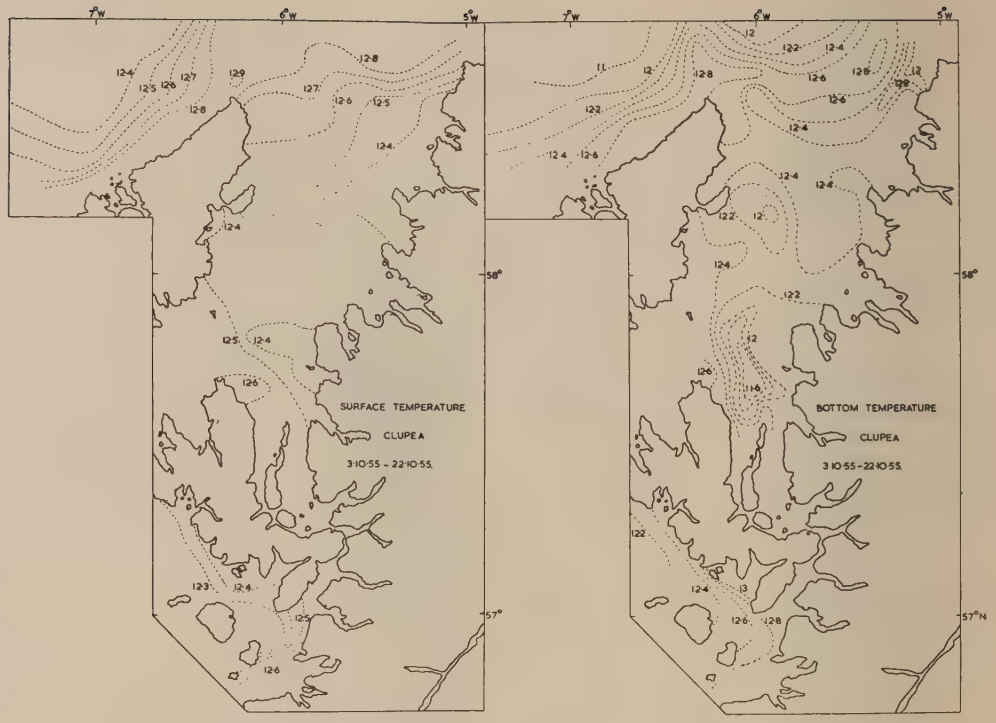


Figure 1a. Temperature conditions in the Minch area, 3.—22. October, 1955.

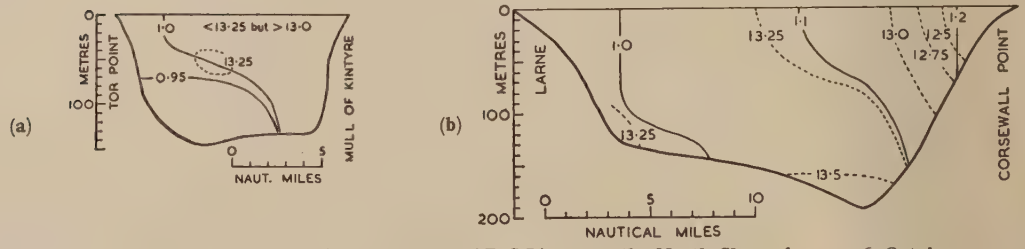


Figure 3. Hydrographical sections (temperature and D.C.I.) across the North Channel, 24.—26. October, 1955.

(a) Tor Point — Mull of Kintyre.

(b) Larne — Corsewall Point.

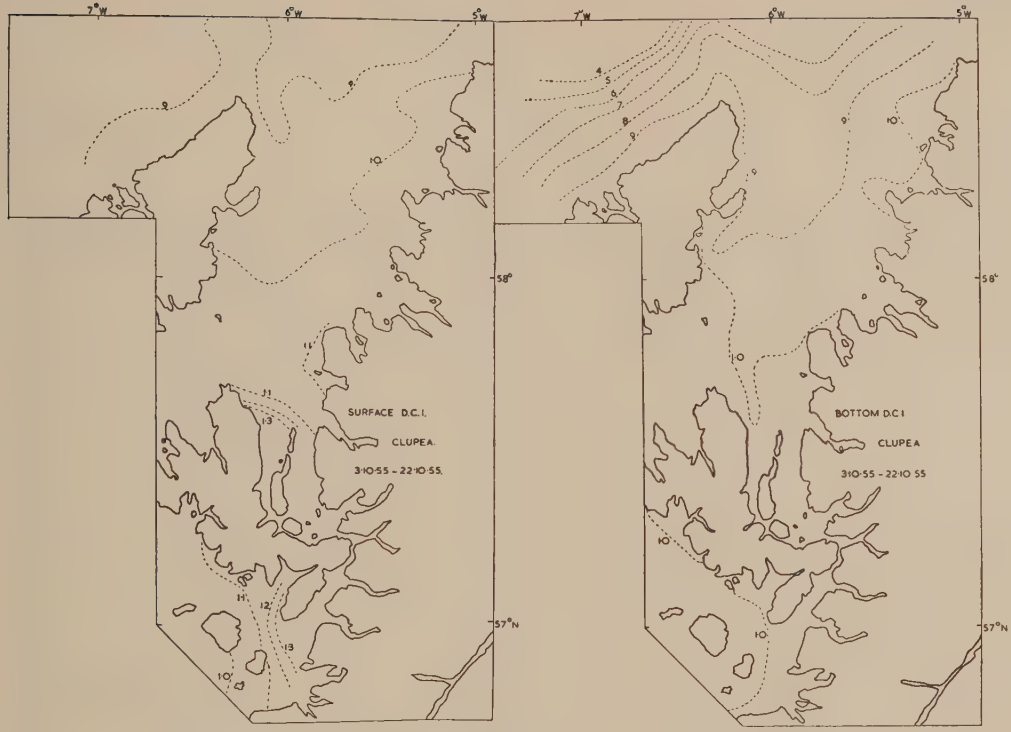


Figure 1b. D.C.I. conditions in the Minch area, 3.—22. October, 1955.

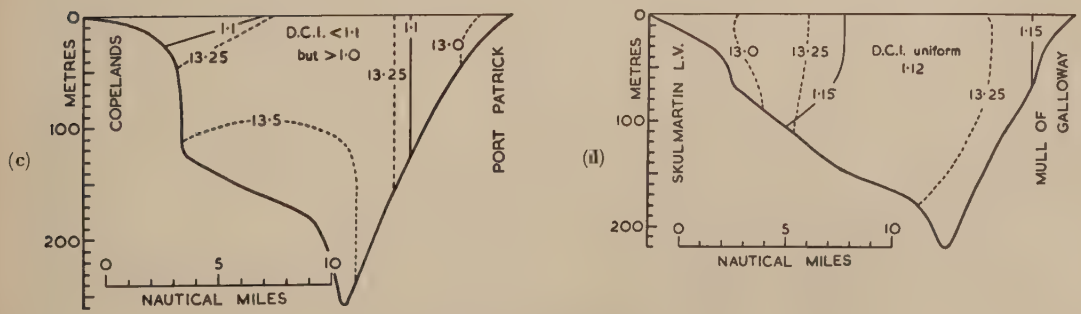


Figure 3 (continued).

(c) Copeland Islands — Port Patrick.

(d) Skulmartin Lightvessel — Mull of Galloway.

Figure 2. Temperature and D.C.I. conditions in the North Channel and Firth of Clyde, 24. October — 3. November, 1955.

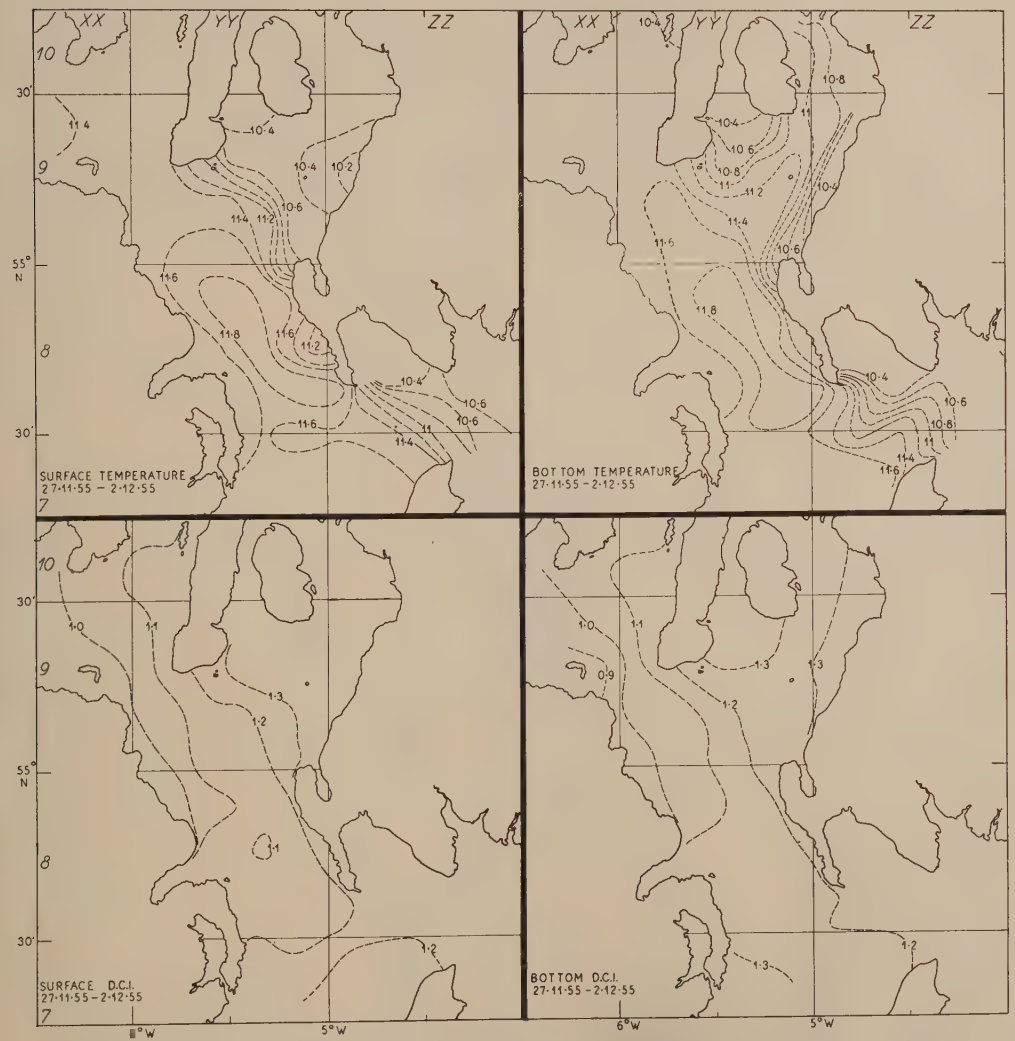
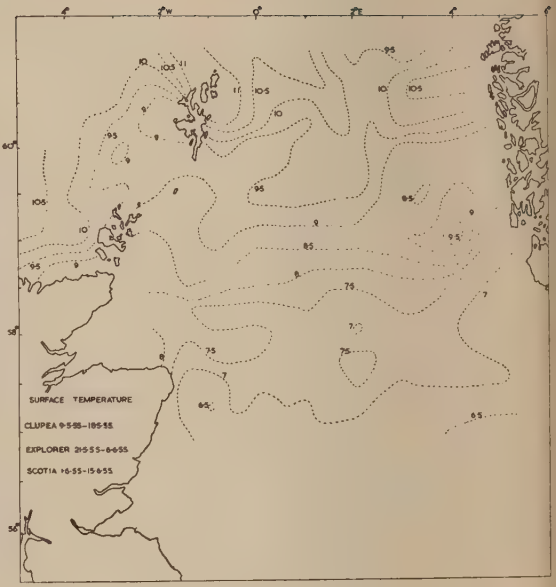
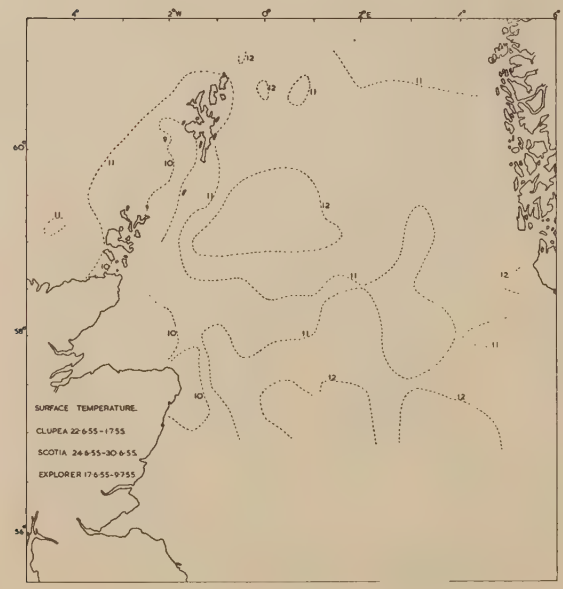


Figure 4. Temperature and D.C.I. conditions in the North Channel and Lower Firth of Clyde, 27. November to 2. December, 1955.

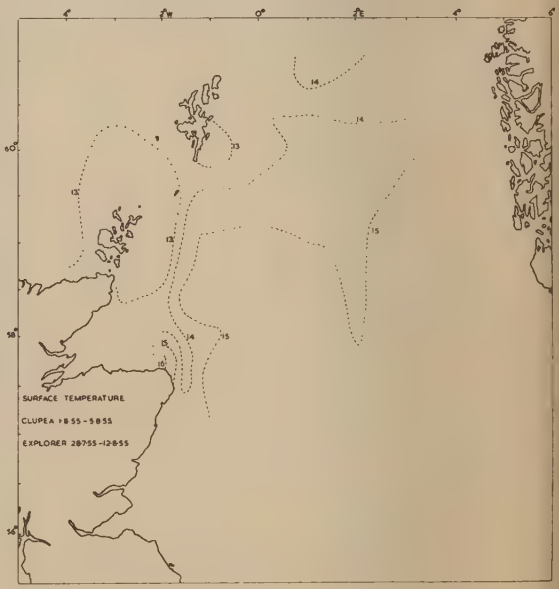
(a)



(b)



(c)



(d)

Figure 5. Surface temperatures of the northern North Sea 1955.

(a) 10. March—8. April
(b) 9. May—15. June
(c) 17. June—9. July
(d) 28. July—12. August

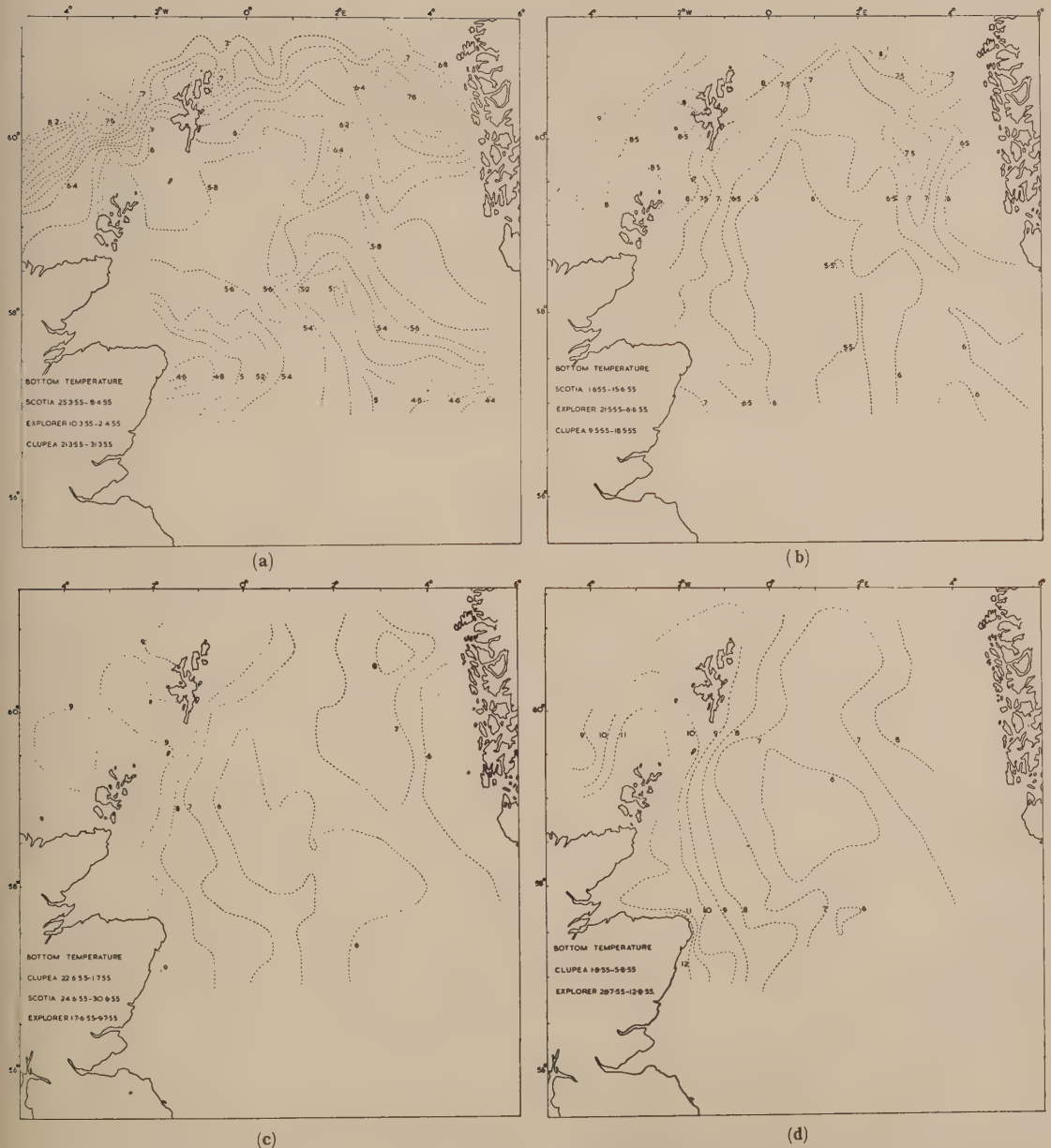

BOTTOM TEMPERATURE
SCOTIA 25 3 55 - 6 4 55
EXPLORER 10 3 55 - 2 4 55
CLUPEA 21 3 55 - 31 3 55
(a)
BOTTOM TEMPERATURE
SCOTIA 1 0 55 - 15 0 55
EXPLORER 21 5 55 - 6 0 55
CLUPEA 9 5 55 - 18 5 55
(b)
BOTTOM TEMPERATURE
CLUPEA 22 6 55 - 17 5 55
SCOTIA 24 6 55 - 30 6 55
EXPLORER 17 6 55 - 9 7 55
(c)
BOTTOM TEMPERATURE
CLUPEA 18 5 55 - 5 8 55
EXPLORER 28 7 55 - 12 8 55
(d)

Figure 6. Bottom temperatures of the northern North Sea 1955. For dates of survey, see Figure 5.

Hydrographic Surveys of the Northern North Sea, 1955 (Figures 5–8)

These four surveys are presented in the same way as those for 1954 (Vol. XI, pp. 37—41), as charts of surface and bottom temperature and D.C.I. (D.C.I. = 1 + Log (35·5 — S) where S is the salinity in parts per mille).

In brief, the data indicate that conditions were much less oceanic than in 1954. In March, oceanic values of temperature and D.C.I. extended about 160 miles less far into the North Sea than in that year.

All temperatures in March, and bottom temperatures in the deep regions throughout the summer,

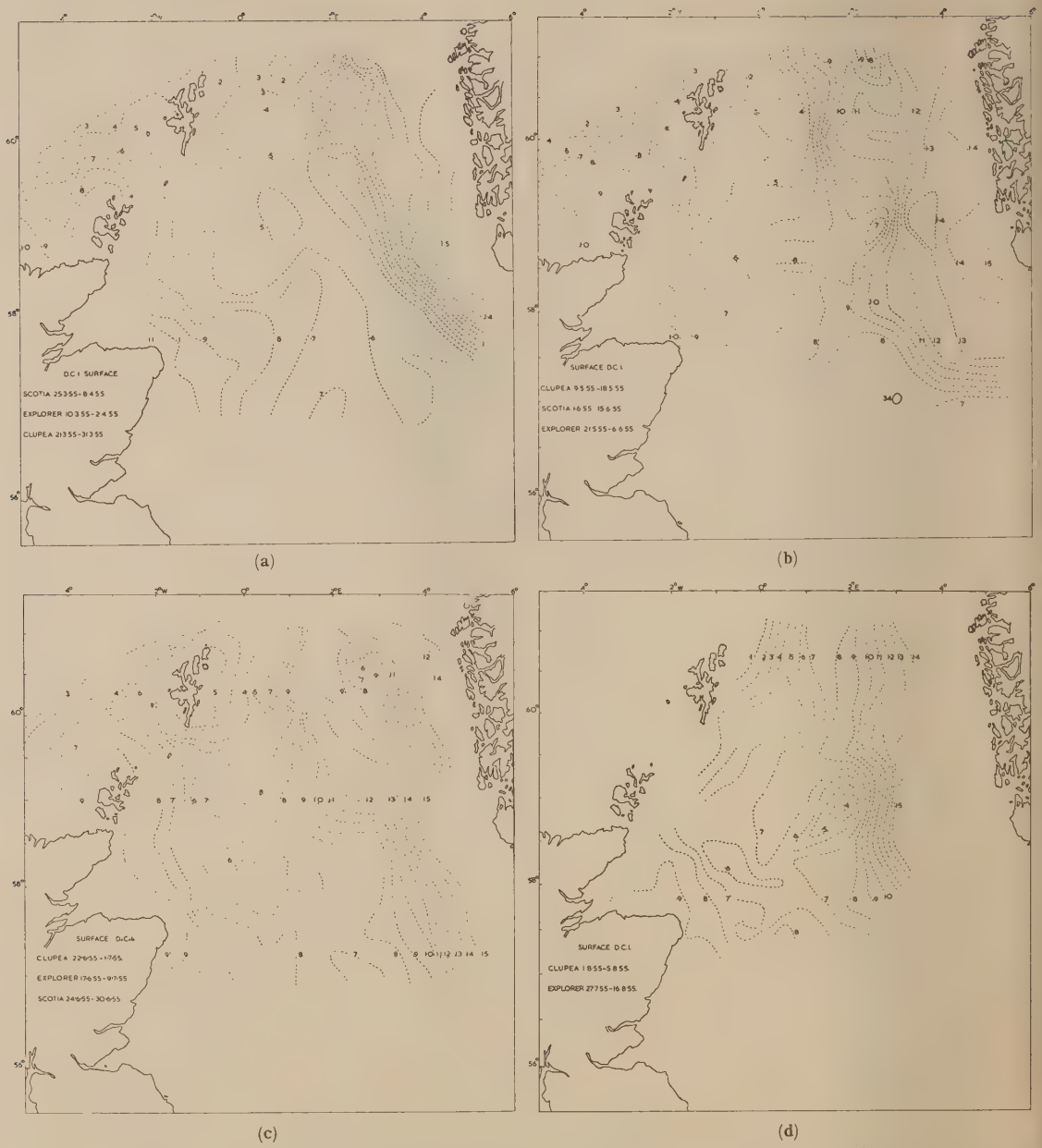


Figure 7. Surface D.C.I. of the northern North Sea 1955. For dates of survey, see Figure 5.

were about 1¼°C. lower than in 1954 and were thus about 1°C. below the long-term mean.

It is clear that the rise in surface temperatures has been largely due to radiation and the temperature pattern has not been dominated by inflowing Atlantic water. Surface temperatures rose well above the long-term mean after mid-July, and in practically the whole region south of 59°N. were in excess of 15°C.

Shetland waters

Coastal water from the region west of Orkney extended up the west coast of Shetland almost to 61°N. during the summer. Thus, though some

Figure 8. Bottom D.C.I. of the northern North Sea 1955. For dates of survey, see Figure 5.

slight inflow through the Fair Isle—Shetland passage might be deduced from the March survey, this appears unlikely to have occurred later. The June survey strongly suggests *outflow* through this passage. Unfortunately it was not possible to cover this region in August. In the southern passage between Fair Isle and Orkney, it seems probable that inflow of coastal water has continued as usual.

To the west of Shetland, D.C.I. remained at values of 0.3 to 0.5. It may be remembered that the June 1954 survey showed values of 0.0 to 0.1 in this region.

Conditions in early spring

The temperature conditions in the March survey show clearly some of the relations between the water masses. The water of highest density is at

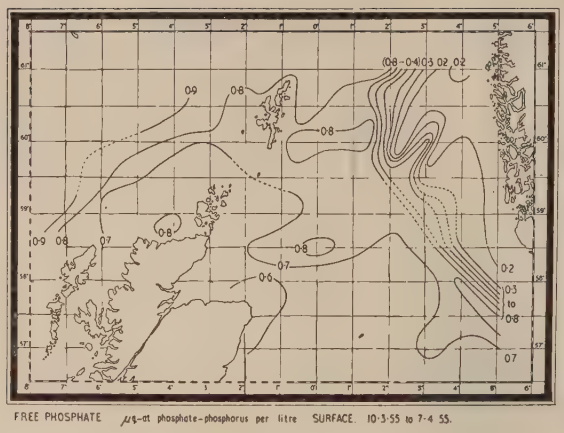


Figure 9.

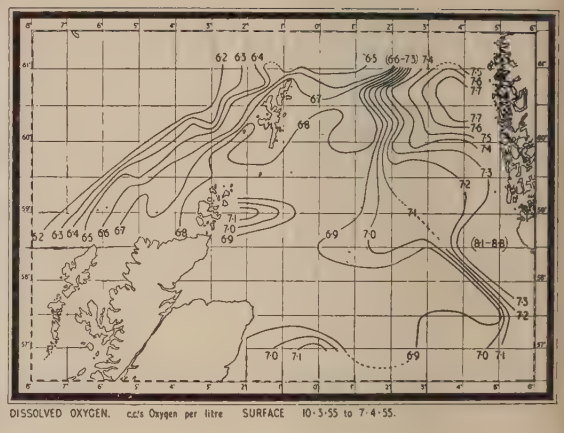


Figure 10.

the bottom in the S.E. corner of the area surveyed, and can be seen to be flowing N.N.W. across the eastern part of the Fladen Ground. Extending east from the Aberdeenshire coast and over this water, is a large body of water from the Scottish coast. The northern water is restricted to the north of these masses, and it appears to be relatively well mixed and far from oceanic in type.

R. E. Craig

Chemical Observations

In the last three issues of the Annales chemical data were presented in the form of winter and summer charts for the northern North Sea and adjacent waters. For 1955 the results of four cruises are available and are confined to the North Sea, north of lat. 57°N. Collateral information on temperature and salinity distribution has been presented in this volume by Craig (p. 65).

The cruises in chronological order are:—

1. March/April — "Scotia", "Explorer" and "Clupea" (Figs. 9 and 10).
2. May/June — "Explorer" (Figs. 11 and 12).
3. June/July — "Explorer" (Fig. 13).
4. July/August — "Explorer" and "Clupea" (Figs. 14 and 15).

Early spring (Figures 9 and 10)

Owing to the severe weather experienced in the winter of 1954/55 no adequate sampling was possible, but the results obtained in the March/April cruise can be used for comparison with previous years.

The nearness of the 0.9 and 0.8 phosphate isolines to the western shelf (Fig. 9) suggests that oceanic water coursing west of Orkney was richer in nutrient in March 1955 than in the three previous winters. Tait (Vol. XI, p. 34) reported that the oceanic incursion into the North Sea waxed in strength at the end of 1954, and drift-bottle strandings within the North Sea, which are indicative of this incursion, suggest that it reached "a high climax in January 1955". This nutrient rich water restored the winter maximum within the North Sea to the level recorded in 1952 and 1953, from the overall decrease of 0.1 units reported by Johnston for 1954 (Vol. XI, p. 41).

Though the 0.9 phosphate isoline failed to enter the North Sea (Fig. 9), as it did enter in 1952, the overall average value within the North Sea (Norwegian coastal water excepted), for a period slightly later in time than in 1952 and 1953, was yet on a par with these years. Evidence that 1955 was, indeed, richer in winter phosphate than the three previous years, is to be inferred from the oxygen values in Figure 10. These values, ranging from 6.6 to 7.1 c.c./l., are from 0.2 to 0.4 c.c. higher than in the three previous years. The temperature structure being roughly the same for all four winters, these higher values together with the small but measurable amounts of chlorophyll that had been produced at this time, indicate that some of the available phosphate had already been consumed.

Early summer (Figures 11 and 12)

There is a remarkable similarity between the results of the May/June cruise of this year and those of June 1953, especially in the disposition of oxygen maxima and minimum. Figure 12 shows two zones of maximum oxygen values, viz., 7.6 c.c./l. to the east of Shetland, and 7.6—8.0 c.c./l. lying

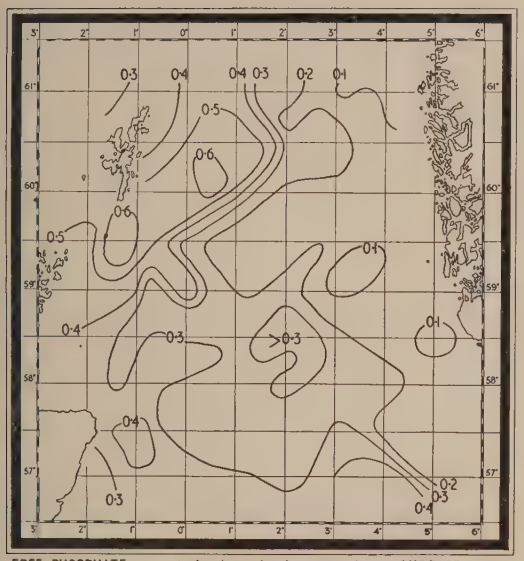


Figure 11.

Figure 12.

athwart the prime meridian in Lat. 59°N. Separating these two "highs" is a tongue of low values (6.6 c.c./l.) stretching east from Fair Isle. In 1953, when the sampling was later, the corresponding values were 7.0 and 6.9 c.c./l. for the "highs" and 6.1—6.5 c.c./l. for the "low". Measurements of chlorophyll in the zones of high oxygen showed that major phytoplankton production was in progress.

Phosphate values (Fig. 11) also show similarity in conformation to June 1953, in so far as the isolines tend to run N.-S., but the proximity of the 0.4 and 0.3 isolines to one another in 1955 suggests a slightly more advanced state of nutrient depletion east of these lines, than was found in 1953. If any conclusion can safely be drawn from these observations, it is that by early summer, phytoplankton production was more vigorous in 1955 than 1953, the only years that can be directly compared.

Late summer (Figures 14 and 15)

The results for July/August 1955 can be compared with those of 1954, which covered the same period.

This year, except for one station north of Shetland, almost total exhaustion of phosphate was found in large areas west of 3°E. Measurable production in the upper 10 m. was found at Flugga and in the S.W. corner of the area sampled where oxygen values of 6.0 c.c./l. were found. Elsewhere, chlorophyll production was confined to the 30 and 50 m. depths. In 1954, north of a line drawn S.E. from Fair Isle to the junction of 57°N., 4°E., similar exhausted conditions were found; but south of this line measurable amounts of phosphate from 0.4 to 0.2 units occurred in patches. This difference can possibly be accounted for by the suggested incursion of oceanic water in July 1954 round the north of Shetland and through the Fair Isle passage at lower depths, illustrated by Craig in Vol.XI, p. 39, Figure 5c and p. 40, Figure 6c. This incursion

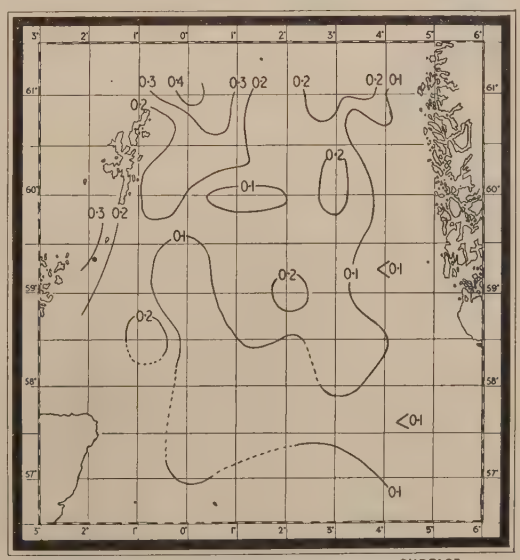
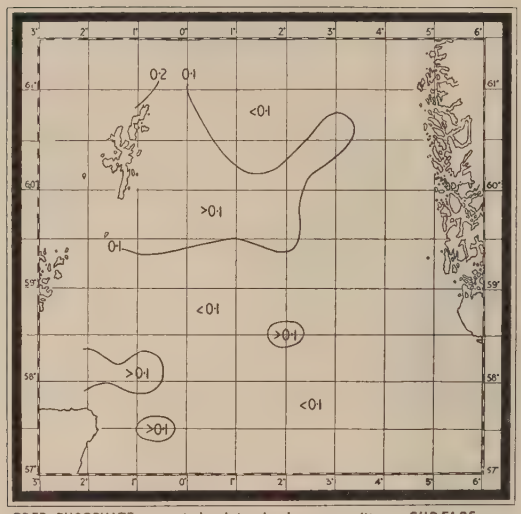
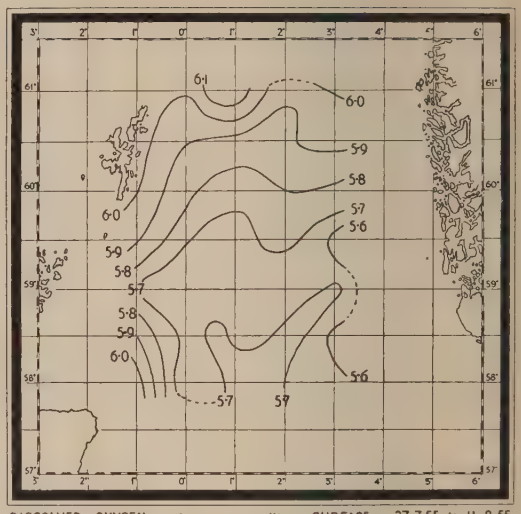


Figure 13.



FREE PHOSPHATE. µg.-at. phosphate—phosphorus per litre. SURFACE. 27·7·55 to 11·8·55

Figure 14.



DISSOLVED OXYGEN. c.c.'s oxygen per litre. SURFACE. 27·7·55 to 11·8·55.

Figure 15.

left a patch of high salinity water near the bottom, S.E. of Fair Isle on the prime meridian.

No such incursion took place in July 1955. Indeed it was the month when oceanic influence appeared to be nil. In August 1955 oceanic influence was confined to the east of Shetland, north of 60°N. Moreover, owing to the prolonged good weather in 1955, the more strongly established thermocline precluded any replenishment.

Oxygen results (Fig. 15) are similar to those of 1954.

Figure 13 shows an intermediate step in the depletion of phosphate from early to late summer. Higher values are to be found round Fair Isle and on Lat. 61°N. Turbulence readily accounts for the phosphate round Fair Isle—there being no thermocline at this time (June/July); but the high values on 61°N. are more difficult to account for. They are practically the same as were found four weeks earlier (Fig. 11), yet oceanic influence at this time appeared to be nil.

The corresponding oxygen values for June/July were too few to provide an accurate picture. At this time however, the pattern of oxygen in Figure 12 had already broken down; the picture was not unlike Figure 15, but with slightly higher values.

In Vol. X, p. 86, from an examination of phosphate and oxygen results in the North Sea, JOHNSTON pointed out that four main zones of phytoplankton activity emerge. The 1955 results confirm this observation; as it simplifies the overall picture, which with modifications is repeated every year, it is worthwhile elaborating on it.

(a) Norwegian coastal water is distinct from the remainder of the North Sea, and has the simplest chemical history. By the end of March the spring bloom is at its height; very high oxygen values (7.3—8.8 c.c./l. in 1955) and low phosphate (ca. 0.2 units) result. The steep phosphate and oxygen gradients in Figures 9 and 10 demarcate this zone. The first bloom quickly dies and, with no replenishment owing to the stable structure of the surface layers, by late summer this zone provides the lowest oxygen values and negligible phosphate (Figs. 14 and 15).

In (b), Scottish coastal waters, particularly to the east of Fair Isle and Peterhead, the outburst occurs earlier than in (c) and (d). It quickly declines, perhaps owing to vigorous grazing, with a consequent fall in oxygen values; in contrast to zone (a), however, owing to local turbulence, phosphate in the surface layers is not seriously depleted till late summer. Figures 11 and 12 illustrate this for 1955—where the low oxygen value of 6.6 c.c./l. round Fair Isle occurs with phosphate of 0.6 units. East of Peterhead only the moderate phosphate value of 0.4 units is shown.

The remainder of the North Sea can be divided roughly in two zones by the 0.4 and 0.3 phosphate isolines in Figure 11 and/or by the 7.0 c.c./l. oxygen line in Figure 12. To the east of these lines is an area, zone (c), where depleted phosphate and high oxygen values show that the major bloom is nearly over by early summer. To the west of these lines, zone (d), are to be found high oxygen values with some depletion of phosphate, indicating that

major phytoplankton production is still in progress. The main bloom in zone (d) begins a shade later than in zone (c), but may be more prolonged owing to the renewal of phosphate through oceanic incursion round Shetland and via the Fair Isle passage.

This will be the last report in this series.

R. B. Burns

Monthly Anomalies of the Surface Temperature in an Area off the Eastern Coast of Scotland in 1955

(Figure 16 and Table 3)

Table 3 gives for each month of 1955 the anomaly of the surface temperature in the area F (56°-60°N., 0°-3°W., see Figure 16), the grand monthly means for 1°-squares over the period 1876-1915 being used as standard.

Table 3. Monthly Anomalies (△°C.) and Numbers (n) of Observations of the Surface Temperature in the Area F (see Figure 16) in 1955

Jan.		Feb.		March		April		May		June		July	
△	n	△	n	△	n	△	n	△	n	△	n	△	n
0.1	45	0.0	32	−0.2	53	0.1	49	0.0	67	0.2	64	1.3	77

Aug.		Sept.		Oct.		Nov.		Dec.		Average
△	n	△	n	△	n	△	n	△	n	of △-values
1.6	69	1.3	62	0.4	58	0.7	54	0.6	41	0.5

It appears from Table 3 that positive anomalies are still highly predominant. In fact, only one of the monthly anomalies given in Table 3 is negative. For the first six months of the year the anomalies are very small, just as in the last six months of 1954. Then a sudden increase took place. Averaged over the year the anomaly is 0.5°C. which is the same as for 1954.

Jens Smed

Hydrographic Conditions in the Central and Northern North Sea in August 1955 (Figures 17-20)

During a cruise in the North Sea from 29. July to 24. August the R/V "Anton Dohrn" worked 77 hydrographical stations. Their positions are shown in Figure 17. The station network on the Fladen Ground and in the eastern region of the Dogger Bank is comparatively fine and permits detailed observations; for the other localities the stations are far apart and therefore give only the main outlines.

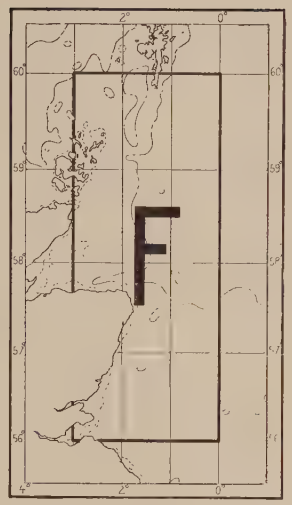


Figure 16. Location of area.

Figures 17 and 18 show temperature and salinity at the bottom. Figures 19 and 20 show temperature and salinity in two sections, one running from west to east nearly along 58°N., the other from north to south along the main axis of the North Sea. The course of the two sections are given in Figure 18.

The sections show the characteristics of the summer stratification such as they were found in August 1953[1]). The homogeneous surface layer is separated from the homogeneously or faintly layered substratum by the summer discontinuity layer which is situated south of the Dogger Bank at a depth of 20 m. and north of the Bank at 30 m.

Dependent on the effectiveness of the turbulence caused by the tidal streams, four typical regions of stratification appear in Figures 19 and 20, viz.:—

1. The substratum is stratified, the thermocline is relatively broad. The effects of the turbulence of tidal streams are limited to a thin mixing layer near the bottom. The stratification on the Fladen Ground north of station 300 is typical of this region.

2. The substratum is homogeneous as an effect of relatively higher turbulence, but the thermocline remains comparatively broad. The stratification of the central North Sea north of the Dogger Bank to station 300 is typical of this region.

3. The substratum is homogeneous, the thermocline is narrow owing to high tidal turbulence. The stratification of the region south of the Dogger Bank is typical.

[1]) G. Dietrich, Ann. Biol., X, 1954.

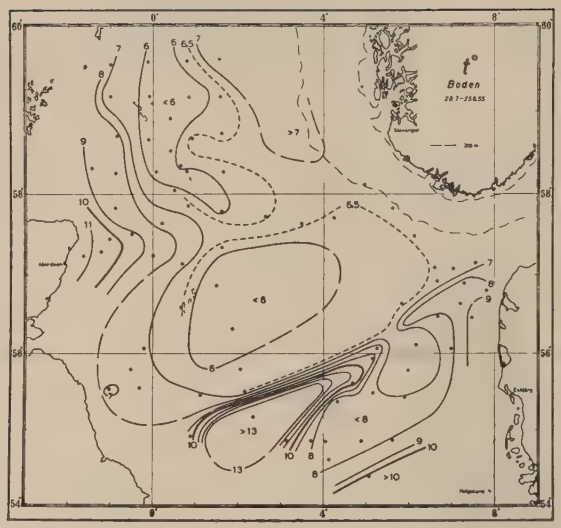


Figure 17. Bottom temperature of the northern and central North Sea in August 1955.

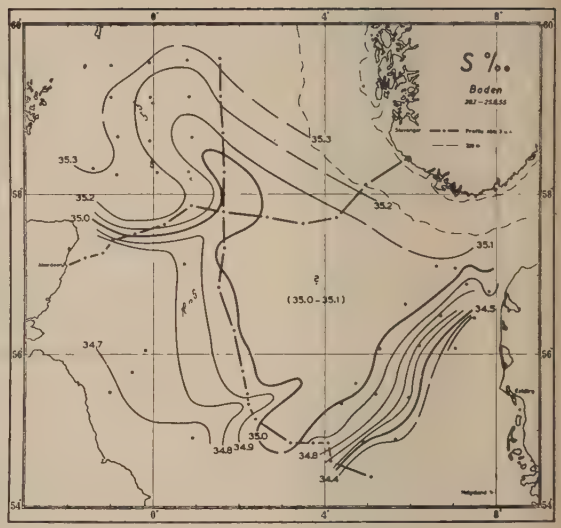


Figure 18. Bottom salinity of the northern and central North Sea in August 1955. The broken line shows the course of the sections illustrated in Figures 19 and 20.

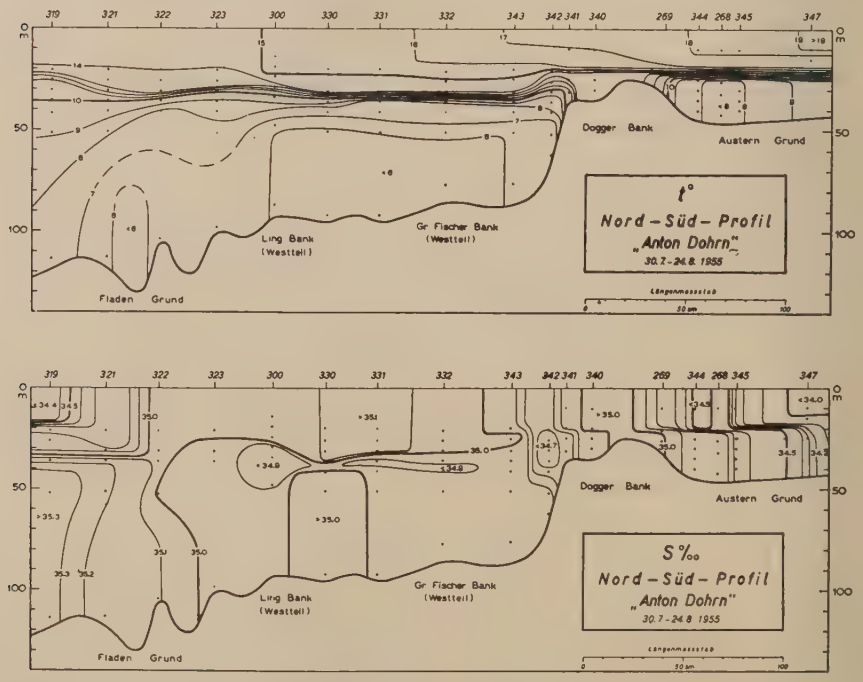


Figure 19. North-south section along the axis of the North Sea in August 1955. For course of the section, see Figure 18.

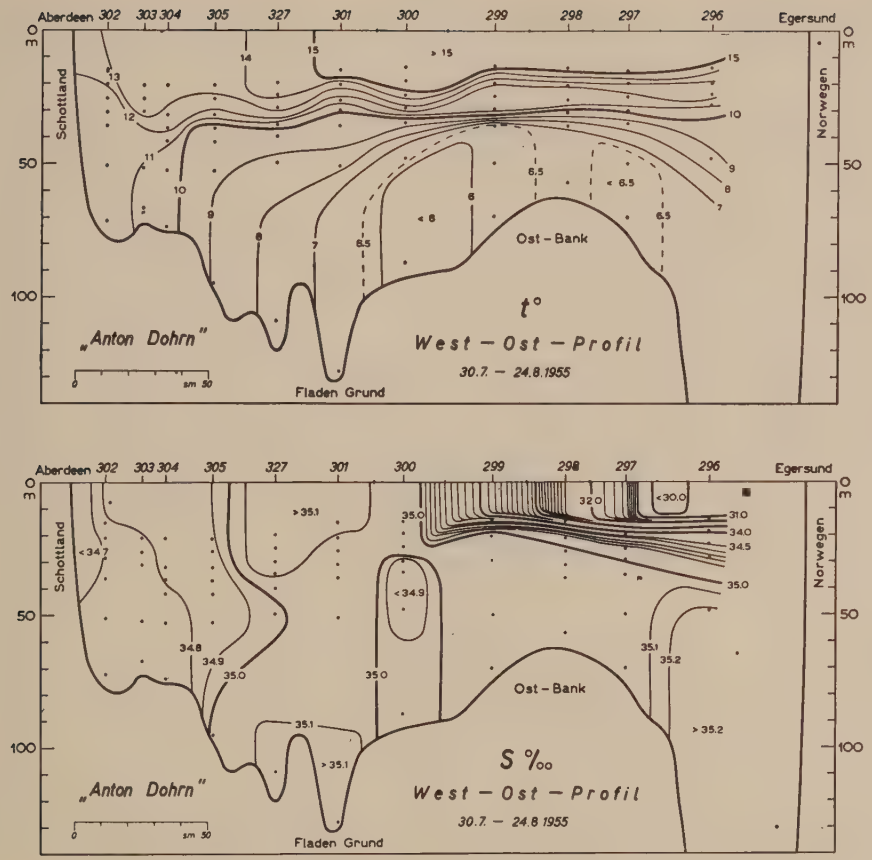


Figure 20. West-east section along 58°N. through the North Sea in August 1955. For course of the section, see Figure 18.

4. The substratum, the thermocline, and the surface layer turn into one homogeneous layer as an effect of very strong mixing of tidal streams. The region near the Scottish coast is typical.

Considering the residual currents and the mixing by tidal streams, the distribution of temperature and salinity at the bottom, shown in Figures 17 and 18, will be understood. There are two centres of cold bottom water to be distinguished, one on Fladen Ground and Bressay Shoal, the other in the Gut, both with temperatures below 6°C. The water in question is cold winter water which later on is separated from the warm surface layer by the summer thermocline, also situated in the centre of cyclonic (counter-clockwise) movements of the North Sea and for this reason does not get any appreciable renewal from the sides.

The temperature in both centres of the winter water are unusually low. This may be explained as an after-effect of the very cold spring (see p. 74). The thermocline, after the summer heating, has preserved the cold water in the substratum.

G. Dietrich

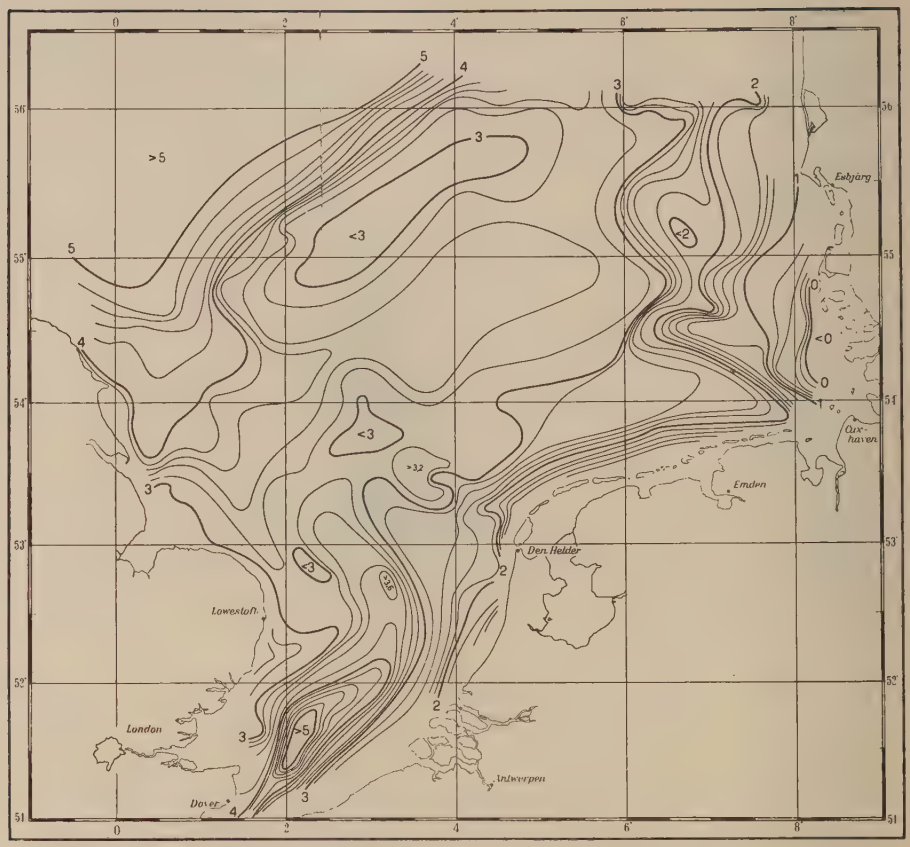


Figure 21. Surface temperature in the southern North Sea in March 1955, based on a multiple ship survey.

Hydrographic Conditions in the Southern North Sea in March 1955, based on a Multiple Ship Survey

(Figures 21–23)

An attempt was made to ascertain, as completely as possible, the distribution of the characteristic water masses in the entire southern North Sea, using the three German research vessels "Anton Dohrn", "Gauss", and "Uthörn", with co-operation of the Dutch lightvessel "Texel" and the German lightvessels "P 8" and "Borkumriff". In view of the dense net of observations of this quasi-synoptical survey, as shown in Figure 22, it might be assumed that no substantial details escaped observation. Distribution of temperature and salinity at the surface (Figs. 21 and 22) reveal a fifth water body on the Dogger Bank in addition to the four main water masses[1]) observed in previous years, namely, English Channel water and water from the central North Sea, both comparatively warm and with high salinity values, as well as Continental and English coastal water, both comparatively cold and of low salinity. The fifth water body is relatively cold due to the winter cooling of the shallow water.

Persistent cold easterly winds contributed not only to the unusually cooling of the whole southern North Sea, but also caused the Channel water of high salinity to be driven off its normal course to the north-west. Moreover, the cold Continental

[1]) G. Dietrich: "Verteilung, Ausbreitung und Vermischung der Wasserkörper in der südwestlichen Nordsee auf Grund der Ergebnisse der "Gauss"-Fahrt im Februar/März 1952." Ber. Deutsch. Wiss. Komm. f. Meeresfor., N.F., 13. 1953.

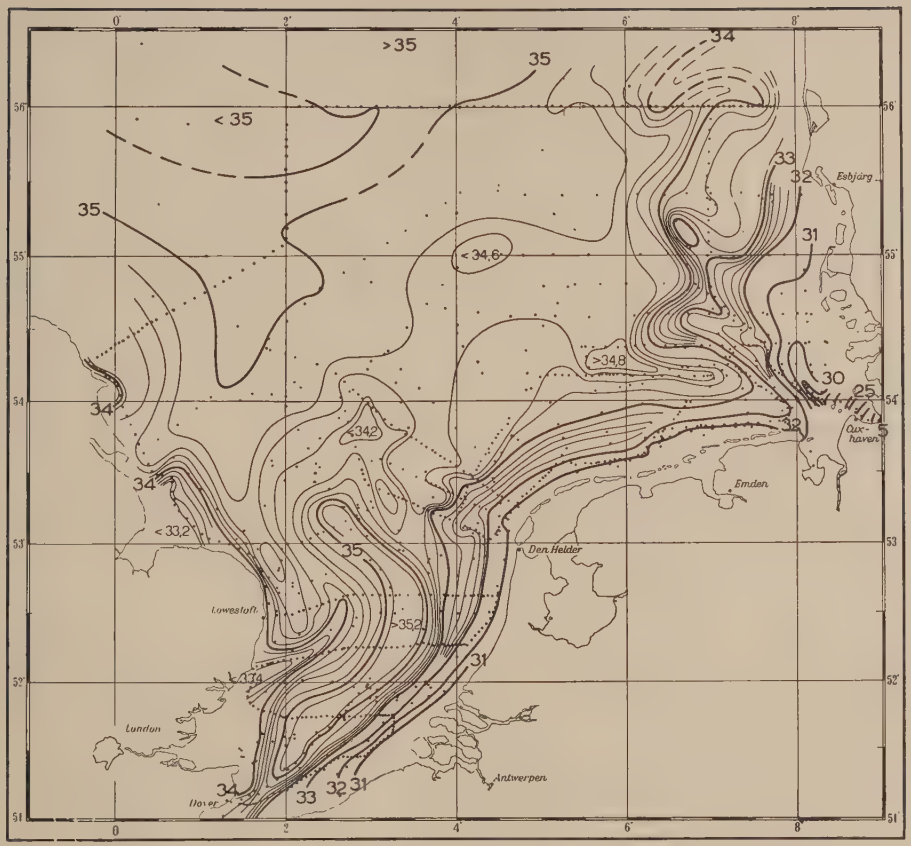


Figure 22. Surface salinity in the southern North Sea in March 1955, based on a multiple ship survey.

coastal water along the North Friesian coast had shifted far to the west. Counter-currents seem to be linked with these shiftings and transport water of high salinity from the central North Sea to the south as far as north of the Thames estuary, and to the east towards the estuary of the river Weser.

With the two bordering water masses, e.g., coastal water, of comparatively low density, and North Sea water, of comparatively high density, a cross circulation is to be anticipated near the coast in the residual currents running parallel to the coast. This cross circulation was (for the first time) systematically investigated. For this purpose 6 paddle wheel current-meters (recording continuously over longer periods of time) were laid out near the bottom, viz., 2.5 m. above the bottom, and 6 paddle wheel current-meters near the surface. The meters were stationed by pairs. They supplied current data over 15 days. Figure 23 shows the daily residual currents obtained for 5 stations near the bottom after eliminating the tidal streams. The length of the arrows is a measure for the velocity. The figures at the points of the arrows indicate the date for which the arrow is valid. A component directed towards the coast is contained nearly without exception in the residual current near the bottom. The velocities lie mainly between 5 and 10 cm./sec., those west of Texel even between 10 and 20 cm./sec. Near Texel and near the North Friesian Islands where there are two stations at different distances from the coast, it has been proved that the movement directed towards the shore decreases with the increasing distance from the coast. In addition, it may be mentioned that, according to the results gained in measuring the residual currents near the surface, seaward directed

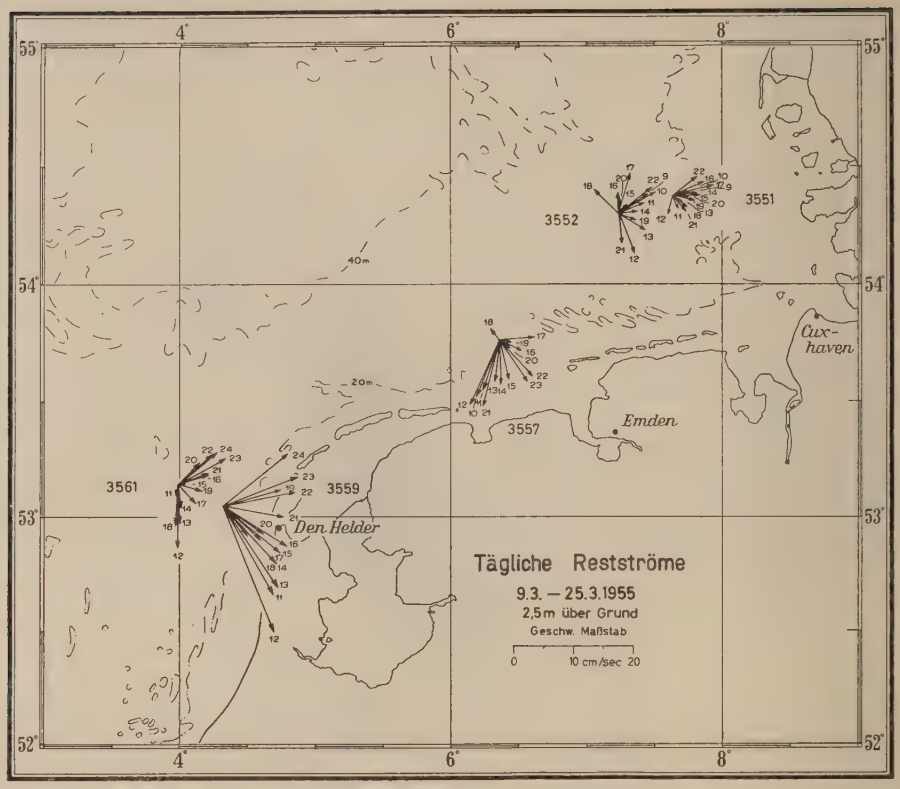


Figure 23. Daily residual current near the bottom in March 1955, based on measurements with 6 paddle wheel current-meters.

movements are prevalent. From this it appears that all suspended matter, as long as it stays near the bottom, will be carried comparatively quickly towards the coast.

G. Dietrich

Hydrographic Conditions in the Southern North Sea, the Bløden Ground Area in 1955

(Figures 24-34)

The weather conditions of 1955 were extraordinary in several ways. The early spring was cold whereas the summer was very warm and abnormally few gales were experienced during summer.

The Danish observations from the area give a good picture of the conditions, as investigations were made in April, May, June, July, August, September and November. Parts of the international R-section were worked 8 times during 1955 and the conditions found are given in Figures 24—34. Phosphate was determined in April, May, and September and the oxygen content at the bottom was examined in April, August, September, and November. The temperatures of April and May were probably below normal, but the salinities were about normal like the phosphate content. As regards oxygen the bottom water was saturated or slightly over-saturated.

The salinity sections from 2/4, 27/4, 1/6 are very similar showing that a rather strong vertical mixing took place. In the later sections the picture is quite different. The water masses became stratified. The isotherms first became horizontal followed by the isohalines. The sections from August and September show this stratification when it attained its highest development. The figures indicate that we have turbulence in the upper ten metres and in the water masses below 20 m. and a turbulence-free layer between 10 m. and 20 m. We have in this way no exchange between the surface and the bottom waters. This agrees very well with the low oxygen content of the bottom water. In September places were found with a saturation percentage of 60. The water masses on Bløden Ground was thus very stable.

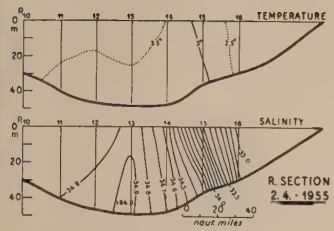


Figure 24. International R-section. Temperature and salinity, April 1955.

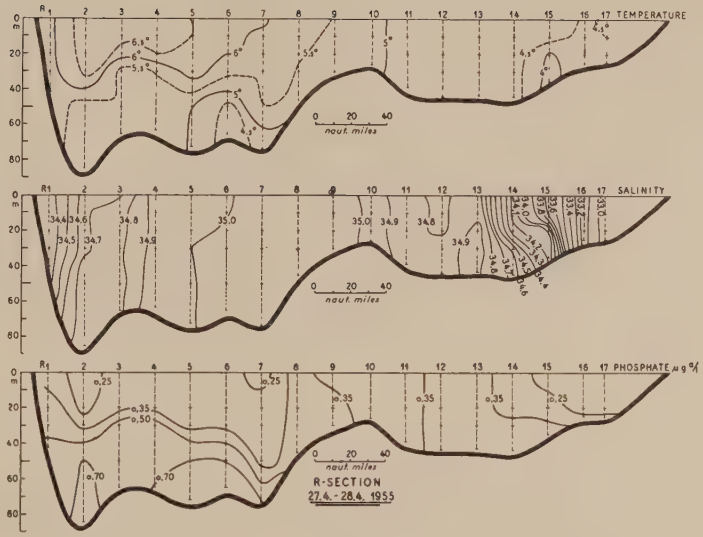


Figure 25. International R-section. Temperature, salinity, and phosphate, April 1955.

Figure 25

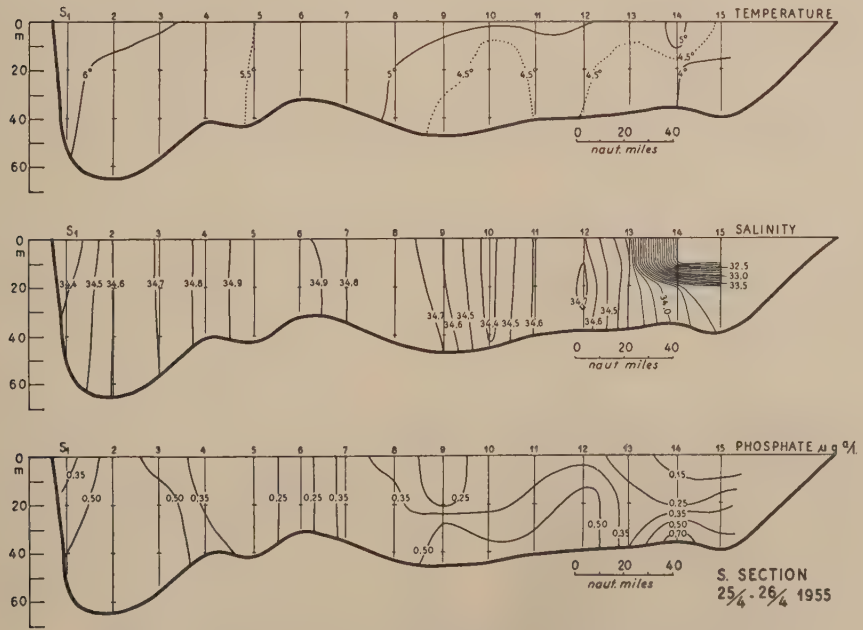


Figure 26. International S-section. Temperature, salinity, and phosphate, April 1955.

Figures 33 and 34 show the September isotherms in the area. A strong gale was blowing in the period between the two sets of observations. The figures show that the effect on the bottom isotherms was relatively slight especially when compared with an analogous phenomenon in September 1954.

The width of the turbulence-free layer was

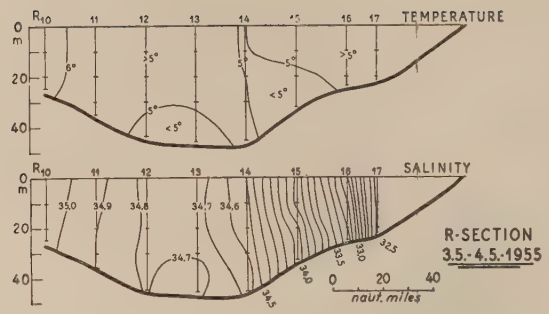


Figure 27. International R-section. Temperature and salinity, May 1955.

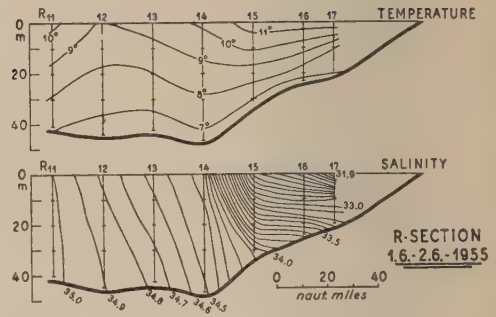


Figure 28. International R-section. Temperature and salinity, June 1955.

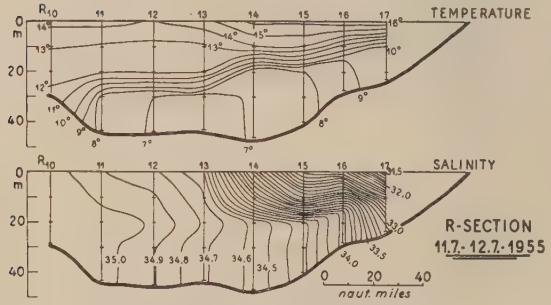


Figure 29. International R-section. Temperature and salinity, July 1955.

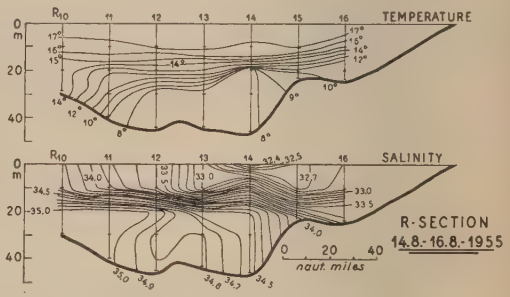


Figure 30. International R-section. Temperature and salinity, August 1955.

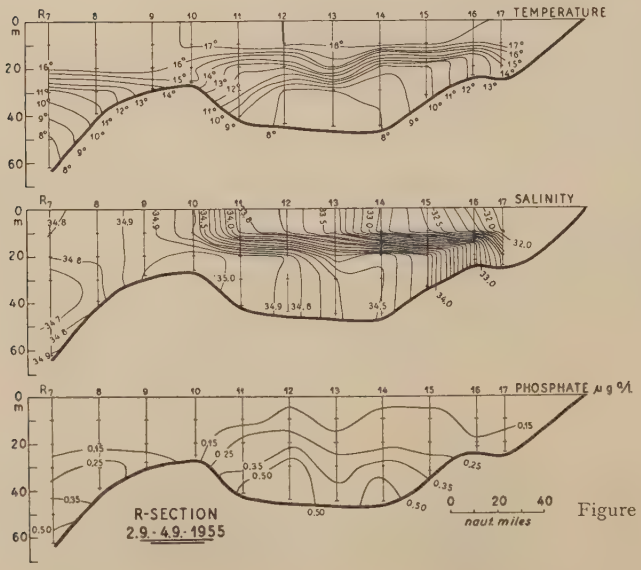


Figure 31

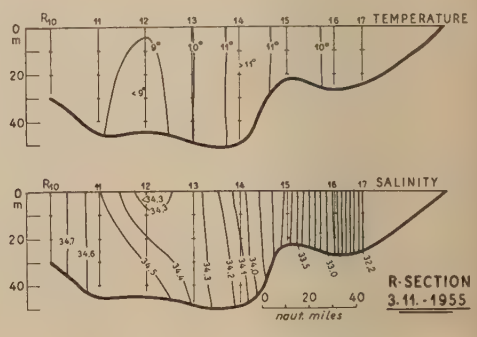


Figure 32. International R-section. Temperature and salinity, November 1955.

Figure 31. International R-section. Temperature, salinity, and phosphate, September 1955.

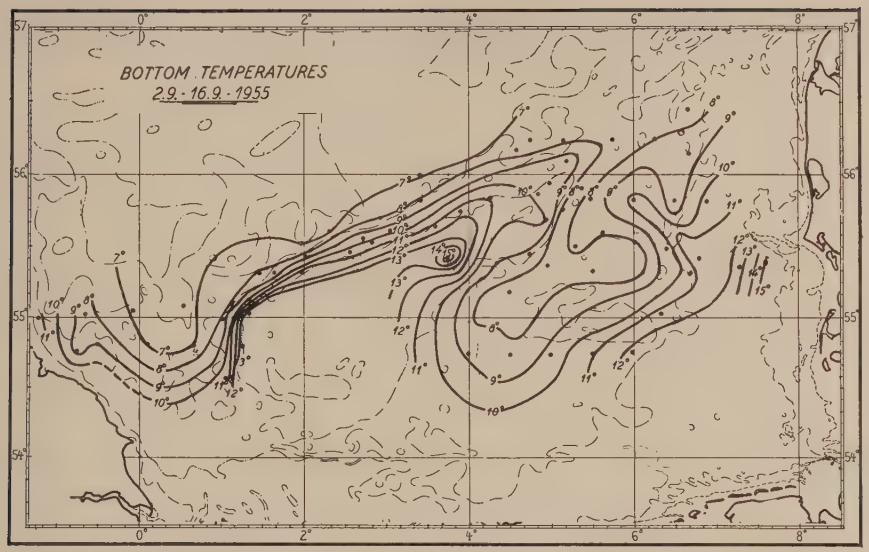


Figure 33. Bottom temperatures in the Bløden Ground area, September 1955.

probably often much smaller than indicated on the sections. Bathythermograph observations often indicated that the width was less than 2 m.

The missing exchange between the bottom and surface also caused the bottom temperature in the centre of Bløden Ground to rise very slowly. In early June the bottom temperature was about 6.5°C. and it was 7.5 in the beginning of September. The surface water temperature rose in the same period from about 8° to about 17°C.

The last section, taken in November, shows that a strong mixing had occurred. This was caused by very strong autumn gales.

K. P. Andersen

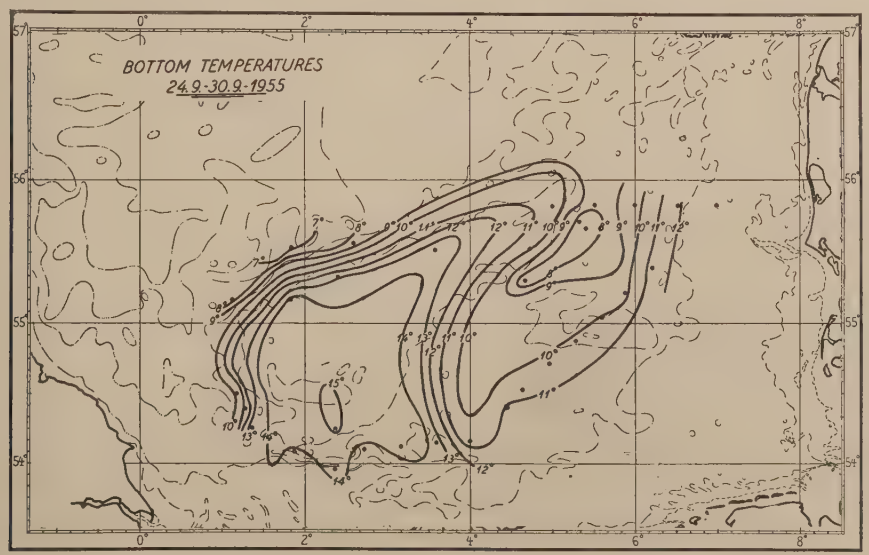


Figure 34. Bottom temperatures in the Bløden Ground area, September 1955.

Table 4. Monthly Means of Salinity and Temperature at Surface and Bottom, 1950/54 and 1955 for the German Lightvessels "Borkumriff", "P 8", "P 12", "Elbe 1", and "Weser"

(From Deutsches Hydrographisches Institut, Hamburg)

Month		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Salinity						**Surface**							
"Borkumriff"	1955	33.98	31.89	32.64	32.57	32.39	32.36	32.59	32.52	32.74	32.57	32.61	32.79
						Bottom							
	1955	34.19	32.17	32.79	32.62	32.42	32.54	32.67	32.62	32.90	32.63	32.74	32.69
						Surface							
"P 8"	Mean 1950/54	33.82	33.77	33.40	33.59	33.04	32.98	33.36	33.18	33.04	33.65	33.91	33.76
	1955	34.07	33.72	33.60	32.70	33.04	32.54	31.78	32.00	33.13	33.23	33.13	32.85
						Surface							
"P 12"	Mean 1950/54	32.77	32.47	32.35	32.19	31.89	32.08	32.15	32.29	32.05	32.36	33.04	32.84
	1955	31.58	32.69	31.77	29.31	30.73	30.13	30.38	31.03	(31.46)[1]	—	31.54	31.25
						Surface							
"Elbe 1"	Mean 1950/54	31.71	33.36	32.95	31.15	31.38	31.80	31.65	32.01	31.53	31.57	32.28	32.03
	1955	30.36	31.20	30.28	28.20	29.59	30.29	30.75	31.25	31.12	31.69	30.45	30.28
						Surface							
"Weser"	Mean 1950/54	31.94	32.00	32.14	32.08	32.45	32.41	32.39	32.27	31.84	32.32	32.47	32.46
	1955	31.84	32.03	32.43	31.61	31.32	31.82	32.02	31.93	32.47	32.12	31.63	31.00
Temperature						**Surface**							
"Borkumriff"	1955	4.2	3.2	2.0	4.4	8.4	11.6	15.7	18.3	17.9	14.5	10.2	7.4
						Bottom							
	1955	4.5	3.4	2.0	4.5	8.4	11.2	15.4	17.9	18.0	15.2	10.3	7.7
						Surface							
"P 8"	Mean 1950/54	5.6	3.6	3.7	5.4	9.4	13.2	15.5	16.8	16.3	13.6	10.7	7.5
	1955	4.8	3.4	2.1	4.3	7.0	11.2	16.3	18.1	17.2	15.0	11.3	8.2
						Surface							
"P 12"	Mean 1950/54	4.9	3.1	3.5	5.6	10.1	13.5	15.9	17.1	16.1	13.1	10.4	7.2
	1955	3.5	2.6	1.5	4.7	8.1	11.4	15.8	18.0	(17.8)[1]	—	10.1	7.0
						Surface							
"Elbe 1"	Mean 1950/54	3.9	2.4	3.3	5.8	9.3	13.2	16.3	17.3	16.0	12.8	9.7	6.2
	1955	3.1	2.1	1.4	4.8	8.5	11.4	15.4	17.3	17.1	13.8	9.2	6.4
						Surface							
"Weser"	Mean 1950/54	3.9	2.5	3.1	5.9	9.2	13.0	16.0	17.2	16.9	12.8	9.6	6.3
	1955	3.3	1.8	1.7	4.4	8.5	10.8	15.3	17.3	17.3	13.6	9.6	6.5

[1]) Based on observations from less than 15 days.

Hydrographic Conditions in the German Bight

(Table 4)

Daily surface observations (at 0800) of temperature and salinity have been carried out in 1955 by five German lightvessels in the manner in which it has been done since 1949. The individual values will be published in a year-book entitled "Meereskundliche Beobachtungen und Ergebnisse". In addition, monthly means are given below. The observations of the five lightvessels "Borkumriff" (53°45′N., 6°24.2′E.), "P 8" (54°16′N., 7°11.5′E.), "P 12" (54°00′N., 7°51.5′E.), "Elbe 1" (54°00′N.) 8°10.7′E.) and "Weser" (53°51.6′N., 7°53.3′E.), are representative of the estuaries and coastal waters of the German Bight.

The "Borkumriff" only made hydrographic observations once a week at various depths. Table 4 shows the mean values of the bottom observations.

From January to June 1955 the surface temperatures were relatively low, but relatively high from July to October, and about normal in November and December, compared with the monthly means of 1950/54.

The surface salinity at the four lightvessels, which carried out observations of longer duration, was relatively low from April to August and in

Table 5. Monthly Means of Salinity and Temperature at Surface and Bottom at the Lightvessel "Vyl" for a longer Series of Years, and Deviations from these Means

(From the Danish Meteorological Institute, Nautical Department)

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	IX	XII
Salinity					**Surface**							
Mean	32.6	32.4	32.2	32.4	32.3	32.6	32.5	32.4	32.6	32.4	32.4	32.9
Deviation 1955	1.0	0.3	0.8	0.1	−0.1	−0.5	−0.6	0.2	−0.4	−0.2	0.3	−0.9
					Bottom (20 m.)							
Mean	32.9	32.7	32.7	32.7	32.6	33.0	32.8	32.6	32.7	32.6	32.6	33.0
Deviation 1955	1.0	0.5	0.4	0.0	0.0	−0.1	0.2	0.6	−0.1	−0.1	0.4	−0.8
Temperature					**Surface**							
Mean	3.2	2.2	2.6	4.8	8.8	12.4	15.2	16.1	15.0	12.2	8.5	5.4
Deviation 1955	0.9	0.4	−0.8	−1.3	−1.8	−0.7	0.5	1.0	1.8	1.6	1.4	1.1
					Bottom (20 m.)							
Mean	3.8	2.6	3.0	4.8	8.0	11.1	14.1	16.0	15.1	12.7	9.1	6.2
Deviation 1955	0.4	0.6	−1.2	−1.5	−1.6	−2.8	−3.8	−4.4	0.6	1.3	0.9	0.4

November and December 1955. Therefore, the annual means of the surface salinity in the German Bight in 1955 are extraordinarily low in comparison with the means for 1950/54:—

	"P 8"	"P 12"	"Elbe 1"	"Weser"
1950/54 ...	33.46	32.37	31.95	32.23
1955	32.98	31.08	30.46	31.85

G. Dietrich

Hydrography of the Kattegat Area

Danish Waters (Tables 5 and 6)

The Kattegat was covered in ice at the end of February and the beginning of March. Due to the cold weather the surface temperature was below normal during the first six months of the year. During the remaining months the surface temperatures were well above normal; they were highest in August with mean temperatures up to 3.5° above the normal. The stratification of the water was very pronounced in summer when low bottom temperatures occurred simultaneously with high surface temperatures.

The surface salinities were below normal during the summer and above normal in May, and October/November. The bottom salinity was slightly above normal throughout the year, the greatest deviations from normal values occurring in the winter months and in August.

H. Thomsen

Table 6. Monthly Means of Salinity and Temperature at Surface and Bottom at the Lightvessel "Anholt Nord" for a longer Series of Years, and Deviations from these Means

(From the Danish Meteorological Institute, Nautical Department)

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Salinity					**Surface**							
Mean	23.5	23.1	20.2	19.2	18.1	18.9	19.4	20.1	20.7	20.7	21.9	22.8
Deviation 1955	0.2	1.3[1])	—	0.5	2.7	−1.2	−1.5	−2.3	−0.8	2.5	1.9[2])	3.0
					Bottom (30 m.)							
Mean (28 m.)	31.8	32.0	32.5	33.0	33.1	32.8	32.3	31.9	31.8	32.2	32.4	32.
Deviation 1955	1.3	1.7[1])	—	1.1	0.3	0.4	0.7	1.4	0.9	0.2	0.4[2])	0.
Temperature					**Surface**							
Mean	2.2	1.4	1.9	4.5	9.4	14.2	16.8	16.7	14.5	10.9	7.1	4.
Deviation 1955	0.0	−0.7[1])	—	−1.2	−1.5	−0.9	1.3	3.0	2.6	1.5	1.1[2])	0.
					Bottom (30 m.)							
Mean (28 m.)	6.1	4.7	4.3	4.3	4.9	6.7	9.7	12.7	13.1	12.1	10.2	8.1
Deviation 1955	0.8	0.5[1])	—	0.6	0.1	−0.8	−1.4	−4.9	−1.3	1.1	1.3[2])	−0.5

[1]) Mean of 22 days for the surface and for 21 days for the bottom. [2]) Mean of 24 days.

Table 7. Monthly Means of Salinity and Temperature in 1955 at Surface and Bottom for the Swedish Lightvessels "Vinga" and "Svinbådan", and Deviations from Normal Values (Mean Values 1923—52)

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Salinity					**Surface**							
"Vinga"	23.7	21.4	(19.5)	21.4	23.5	19.9	19.0	18.5	23.6	25.9	26.7	28.6
Deviation	−1.4	−3.3	−3.8	−1.1	+4.1	−0.7	−2.9	−3.0	+0.6	+0.5	+1.5	+4.0
"Svinbådan"	14.0	12.5	—	13.6	14.5	11.1	12.6	10.5	15.0	16.4	17.5	17.8
Deviation	−2.3	−3.2	—	±0	+2.7	+2.5	−0.5	−2.6	+1.2	+0.8	+2.0	+1.8
					Bottom							
"Vinga"	34.2	34.5	(34.1)	34.6	33.9	34.1	33.7	34.3	33.6	33.2	33.7	33.5
Deviation	+0.4	+0.7	−0.2	+0.4	−0.5	±0	−0.1	+0.7	−0.3	−0.3	−0.3	−0.3
"Svinbådan"	27.4	30.4	—	32.1	28.5	28.9	31.3	31.6	28.5	26.4	27.7	25.8
Deviation	−3.0	+0.5	—	+0.5	−3.6	−2.4	+1.5	+1.9	−0.9	−2.8	−2.5	−3.9
Temperature					**Surface**							
"Vinga"	2.1	0.3	(0.1)	3.4	7.9	13.8	18.5	19.8	16.8	12.3	8.3	5.0
Deviation	−0.6	−1.3	−1.8	−1.5	−2.3	−0.7	+1.1	+1.8	+1.4	+0.9	+0.6	+0.3
"Svinbådan"	1.9	0.7	—	3.4	7.8	12.7	17.9	19.5	17.2	12.1	7.5	4.1
Deviation	−0.5	−0.8	—	−1.0	−1.5	−1.1	+1.0	+2.2	+2.2	+1.0	±0	−0.2
					Bottom							
"Vinga"	6.1	4.5	(5.6)	5.2	5.3	5.9	7.5	8.2	10.8	12.4	10.1	7.2
Deviation	±0	−0.6	+0.2	+0.2	−0.2	−1.1	−1.8	−3.0	−1.2	+0.6	+0.6	−0.7
"Svinbådan"	5.3	5.9	—	4.8	6.2	7.6	7.8	8.6	10.6	11.7	9.4	5.8
Deviation	−1.3	+1.0	—	−0.3	+0.3	+0.6	−1.6	−2.4	−1.4	+0.2	−1.3	−2.7

Swedish Waters (Table 7)

The surface salinity was below normal during the first four months of 1955, while May was characterized by unusually high salinity values due to strong westerly winds. During the autumn the surface salinity was found to be fairly high. The bottom salinity at "Vinga" was practically normal throughout the year, whereas the "Svinbådan" showed a negative deviation during the last months of the year.

The cold winter with extensive ice formations is reflected in the surface temperatures. On account of the ice "Svinbådan" did not make observations in March, "Vinga" only in the latter half of the month. The thermocline was strongly developed in July—September, the top layer being much heated and the bottom layer showing temperatures below the normal values.

N. Jerlov

Plankton

Scottish Plankton Investigations in 1955

The four Scottish research vessels continued to take plankton samples during their cruises in 1955, and a report on these investigations is also given to the Distant Northern Seas Committee.

Phytoplankton

By the time the first samples were taken in March and April the spring outburst of diatoms was well established. Neritic species, *Skeletonema costatum* in March and *Thalassiosira gravida* in April, were abundant near both the Scottish and the Norwegian coasts. The central area contained *Chaetoceros* and *Coscinodiscus* spp. and near Orkney and Shetland *Thalassiothrix nitzschioides* was dominant. This distribution is essentially similar to that of 1954 but with a tendency for more southerly North Sea species to be distributed rather farther north in 1955. This similarity remained in May and June when the diatoms dominant in the area south-west of Fair Isle were *Rhizosolenia alata gracillima* and in the Faroe-Shetland Channel *Nitzschia seriata*. The dinoflagellates increased from about 50% of the total phytoplankton in May to about 80% in June, the dominant species being *Ceratium tripos* in the central North Sea, *Peridinium* spp. in the northern North Sea and Moray Firth, and *Ceratium fusus* in the Faroe Shetland Channel.

Records of the diatom *Climacodium frauenfeldianum* Grunow, from 58°46'N., 4°20'W. on

30. June, and from 59°44'N., 7°15'W. on 1. July are worthy of note as unusually far north.

The summer showed the usual minimal figures for dinoflagellates, but contrary to 1954 and most other years there was a great increase in diatom content in the northern North Sea and Faroe-Shetland Channel. This was due to an extensive outburst of *Rhizosolenia alata gracillima* in all areas affected by the oceanic inflow. This continued until September, but it had diminished appreciably by October, though it was present in small numbers until the end of the year. In early October *Guinardia flaccida* was the dominant species in the northern North Sea but this species was displaced southwards in the second half of the month to be replaced by a penetration of *Rhizosolenia styliformis* and *Chaetoceros decipiens*.

The distribution of the phytoplankton in 1955 thus appears to be similar to that of 1954 during the spring and early summer, but it differed in the late summer and autumn when the 1955 conditions were indicative of a greater oceanic influence than in 1954.

A species of parasitic dinoflagellate was found to be heavily infecting radiolaria, and another was found parasitising *Rhizosolenia styliformis*; both are receiving further attention.

Zooplankton

Three dominant features stand out clearly in the 1955 distribution of zooplankton. These are, 1) the concentrations of *Oikopleura labradoriensis* in May off the east Scottish coast, near the bottom, where it formed the major food of commercial haddock feeding in the area at the time; 2) the rich *Calanus* community in the northern North Sea in summer, so that at times the herring became too fatty for good curing; and 3) the exceptionally dense salp invasion which entered the North Sea mostly north of Shetland in the autumn, leaving a relatively static area round Orkney which retained a dominant *Pleurobrachia* fauna for several months, while a band of dense *Calanus* existed between the *Pleurobrachia* and the salps.

Zooplankton was sparse during the first months of the year but by March concentrations of *Calanus* were beginning to develop in the Shetland area and farther north. These increased during the next three months until they extended over almost the whole northern North Sea, except off the east Scottish coast, and a rich *Calanus* fauna existed. It was most abundant at the 20 metre level and below, and noticeably absent in surface collections —which may account for the rather poor numbers found by the continuous recorder (see p. 84). During the early summer *Calanus* became displaced in the Faroe Channel by the incoming oceanic fauna, but it was still very abundant in the northern North Sea in July. This displacement gradually extended, at first concentrating the *Calanus* into a narrow band, from the Butt of Lewis to Shetland, between indigenous *Pleurobrachia* and incoming *Calanus*. Later, from August onwards, the *Calanus* were pushed farther south and the band was broken into local communities, some of which persisted until December.

The Chaetognatha showed little of interest in 1955. *Sagitta elegans* was dominant generally in the northern North Sea, and in places it was abundant; *S. setosa* was found mixed with *S. elegans* south of a line from the Scottish border to Bergen, but with occasional specimens found east of 2°E. as far north as 61°N. in July. Oceanic species were exceptionally sparse even in the Faroe Channel in the first half of the year, and *S. serratodentata* occurred only very rarely.

During May and early June *Oikopleura labradoriensis* was plentiful, but not dominant, in the bottom water layer of the northern North Sea. It was sufficiently abundant for it to become, by selective feeding, the almost pure food of haddock in a wide area off the east Scottish coast.

The overwintering legacies of the 1954 influx persisted in the northern North Sea for several months, as shown by the presence of the siphonophores *Sulculeolaria biloba* (previously referred to in these notes as *Galetta*), *Chelophyes* and *Physophora*, but these gradually died out as the *Calanus* became more abundant. By early spring the new incoming oceanic fauna was found in the south-western part of the Faroe Channel, i. e., south of 60°N., which included the siphonophores *Sphaeronectes, Rosacea, Vogtia, Nectopyramis* and *Agalma*. It was not until the June investigations that the first of the invasions of *Salpa fusiformis* was found and by then they had become abundant over the deep water off the edge of the shelf, north of the band of *Calanus*.

The deep plankton collections to the south-west and north-east of the Wyville Thomson Ridge showed a distinct difference: salps were abundant even in deep water south-west of the Ridge, but not below 300 metres north of it, where *Sagitta maxima* and *Euchaeta norvegica* were present with *Euchaeta barbata* below 500 metres.

The salp community extended northwards in a Y-shaped distribution with arms into the Faroe-Iceland area and into the Faroe Channel, whilst in

the western gap of the 'Y' *Aglantha* dominated the collections. By June the salps had reached Shetland, chiefly in the lower layers, and by July had penetrated into the northern North Sea in masses round the north of Shetland to cover a wide area as far east as Norwegian fjords. The warm summer enabled the salps to multiply rapidly so that numbers in the North Sea still further increased by the production of small agreggate forms which had not themselves been carried by the oceanic drift. Vast masses were obtained as late as October but thereafter they quickly died out, only a few persisting until December. Although it seems evident that the bulk of those brought into the area (as distinct from being produced within the area) came round the north of Shetland, there does seem to be some evidence for a secondary surface inflow via the Fair Isle passage in late rather than early summer. Associated with the dense salp concentrations was an almost complete dearth of other plankton organisms, and as this covered a very extensive area it may have had a serious influence on the dependent fauna. A similar dearth occurred in the inshore areas dominated by *Pleurobrachia*.

As the wave of salps passed along the Faroe Channel and they became reduced in numbers, it was followed by a much greater variety of species, including *Arachnactes* larvae, *Dolioletta gegenbauri*, the siphonophores *Lensia conoidea* and *L. fowleri*, *Vogtia spinosa*, *V. pentacantha*, *Rosacea*, *Nectopyramis thetis*, *N. diomedea*, *Sulculeolaria*, *Dimophyes arctica*, etc., *Diacria trispinosa*, *Clio polita* and also *Lepas fasicularis* frequently attached to floating weed. Another organism worthy of special note is the medusa *Solmaris corona* which was very abundant over a wide area west of Scotland and in the Faroe Channel as far as Shetland. Little of this mixed oceanic fauna ever reached the North Sea. That some inflow was nevertheless present is clearly indicated by the presence of larval *Fierasfer* scattered over a wide area from east of Shetland to east of the Moray Firth in October, November, and December.

Aurelia aurita was rather less widespread than usual, but occurred in dense swarms in local areas, particularly between Faroe and Shetland and south-east of Shetland from September to November. *Cyanea capillata* was very widespread in 1955 and particularly abundant in the north-west of the area and in the central part of the northern North Sea; maximum figures were obtained in August and September. Its abundance on the herring fishing grounds of the northern North Sea had its practical effects in making handling difficult and it was regarded by some members of the trade as partly responsible for spoiling the value of the herring for curing.

The 1955 plankton thus had definite and immediate effects on the fisheries—*Oikopleura* as haddock food; rich *Calanus* in spring and early summer affecting herring; a dearth of other zooplankton where salps or *Pleurobrachia* were abundant, which directly or indirectly produces conditions unfavourable to herring; and *Cyanea* affecting the handling of herring, but which may have some beneficial effects on the survival of some post larval gadoids such as whiting.

J. H. Fraser

The Continuous Plankton Recorder Survey: Plankton around the British Isles during 1955

(Figures 35-45)

The species and groups of species which have been used in these summaries for the past seven years were, in the main, extremely scarce during 1955 and for this if no other reason the histograms of their average monthly abundance do not illustrate the events any too well. However, rather

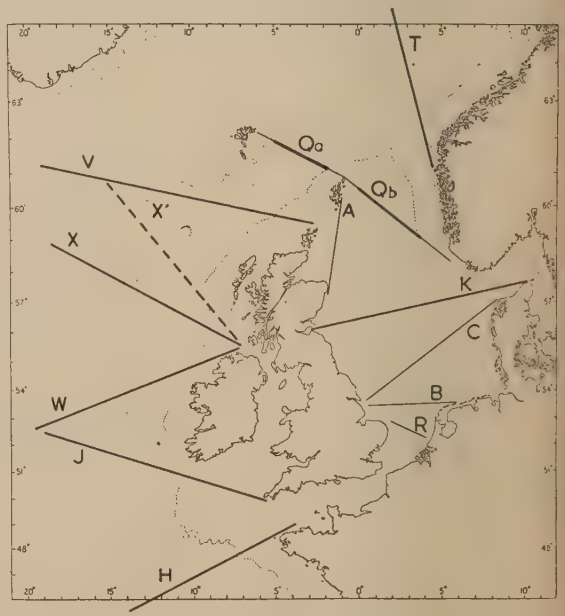


Figure 35. A chart showing the routes along which the Continuous Plankton Recorder was towed during 1955. Those used in the histograms which follow are indicated by a heavier line and in the subsequent figures and in the text they are referred to by their code letters, H, J, W, V, X, Qa, T, Qb and K. The hatched line X' shows the alternative route to X (see also text).

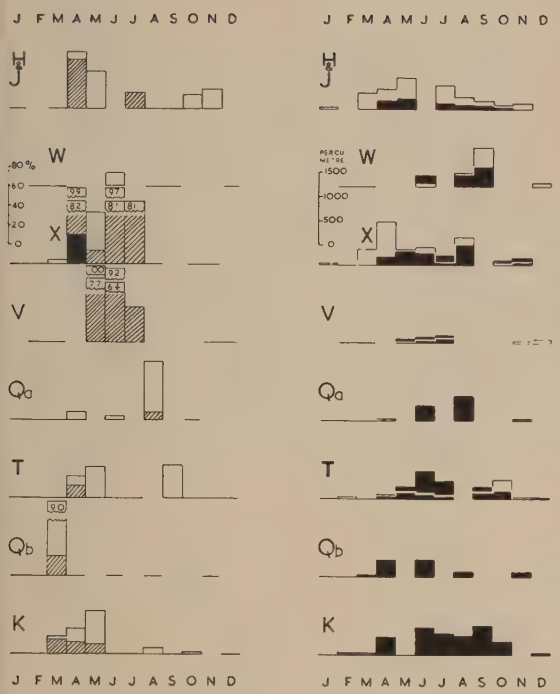


Figure 36. An estimate of the density of *Phytoplankton* month by month on the Recorder routes, H & J, W, X, V, Qa, T, Qb, and K. The histograms show the percentage of the route which sampled water containing various quantities of phytoplankton as estimated by comparing the colour of the filtering silk with an arbitrary colour scale; only that part of the record taken outside the 100-fathom contour is included on routes H & J, W, X, V, Qa, and T. The open part of the histogram represents "pale green", the hatched part "green" and the blacked part "dark green". A gap in the base line indicates that no data were available in the particular month.

Figure 37. Histograms representing the relative numbers of *Total Copepoda* (all species combined) taken month by month on the Recorder routes H & J, W, X, V, Qa, T, Qb, and K. The values represent the number of copepods per cubic metre either for the whole length of tow on routes Qa, Qb, and K or for the two parts of the tow which lie on either side of the 100-fathom contour on routes H & J, W, X, V, and T when the solid histogram shows the numbers over the deeper water and the open histogram over the shallower or coastal water. A gap in the base line indicates that no data were available in the particular month.

than adopt a new method of presentation, the same format is used for the sake of continuity.

All the routes used for the 1954 summary were again available (Figure 35). Unfortunately, however, tows were only obtained on A in June and September but this loss was offset by the introduction of a new route, Q, running from the Skagerak to Faroe. In the histograms this new route is divided into two parts, Qa crossing the Faroe-Shetland Channel and Qb in the northern North Sea. The H route was sampled in January, March, April, July, August (4 times), September (twice), and October; while satisfactory records were obtained on J in March, April, May, October and November (3 times). The X route took the unusual course, X', in March and June. There was also some variation in the position of route V but this is not considered sufficient to influence these broad summaries appreciably.

The superficial estimation of phytoplankton based on the green colouration of the filtering silk (Figure 36) suggests a vigorous spring flowering in the Atlantic on X and V, where in April and May *Rhizosolenia alata*, *Rh. hebeta semispina* and various chaetocerids were exceptionally abundant. As usual, dinoflagellates accounted for a good proportion of the colour during June and July. Again it is noticeable that the spring outburst in the North Sea was earlier than that over the deeper Atlantic water.

For the zooplankton as a whole, 1955 was a particularly lean year. The averages for 'total copepods' (Figure 37) were generally lower than in 1954 which was previously the poorest year since these summaries were started. The number of *Calanus* (Figures 38 and 39) also appear to have been below average; as in 1954 the dense population of 'large *Calanus*' usually found on K in the spring failed to materialize although the young of the spring generation were comparatively plentiful. However, from April to July unusually rich catches of *Calanus* were taken a little further south on the C route (see Figure 35) which is not included in the histograms.

Euchaeta spp. (Figure 40) were scarce and spasmodic in appearance on the Atlantic routes but showed no sign of being restricted to the winter months as was the case in the earlier years (see previous summary, Ann. Biol., XI, p. 56). Those caught on Qb were taken at the extreme eastern end of the route over the Norwegian Deep as might be expected but the appearance off the Firth of Forth on the K route in December was unprecedented in our survey.

Metridia lucens (Figure 41) too were less abundant than usual and showed the time succession from the Atlantic into the North Sea less clearly than usual. Those taken on K from January to March and on Qb in January were well over to the eastern side of the routes and so presumably were the remains of the stock carried in during the previous autumn. A few were taken over the Great Fisher Bank (K) in June and July which may have been

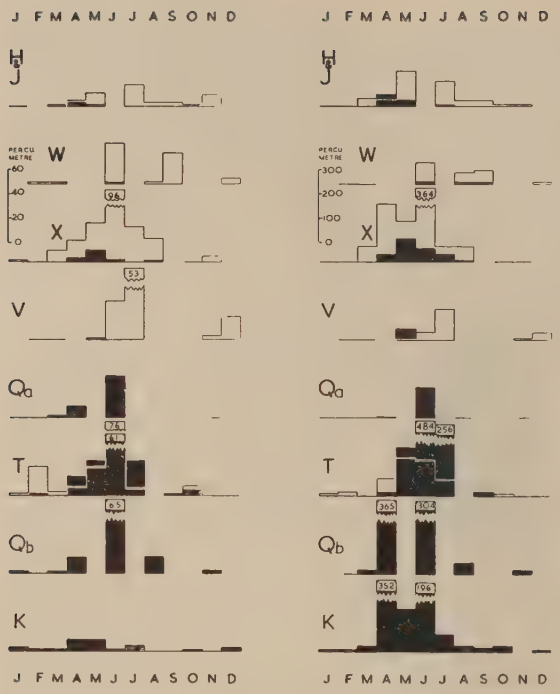


Figure 38. Histograms representing the relative numbers of *Large Calanus* (copepodid stages V and VI) taken month by month on the Recorder routes H & J, W, X, V, Qa, T, Qb, and K. Details as in Figure 37.

Figure 39. Histograms representing the relative numbers of *Calanus* (all stages combined) taken month by month on Recorder routes H & J, W, X, V, Qa, T,Qb, and K. Details as in Figure 37.

carried in during the spring but it was not until October that recruits were found off the Forth, some weeks later than is more commonly the case.

Large *Limacina* (Figure 42) were also extremely scarce during 1955 but their unusually early appearance on K over the Fisher Bank from May to July warrants mention. *Clione* (Figure 43) were taken in exceptionally high numbers on Qa in July just to the south-west of Faroe and some were caught in June off the Moray Firth on the A route which is not included in the histograms. Again as in 1954 they were relatively abundant on the eastern half of K in the summer.

Amongst the indicator species used in these summaries the *Thaliacea* alone were well represented in the catches during 1955. *Salpa fusiformis* appeared exceptionally early on W in March but did not reach X until May. By June they were found near the edge of the Continental Shelf on V and in the Faroe-Shetland Channel on Qa. In July they were still abundant on V just over the edge of the Continental Shelf and in August they were taken in to the immediate north-west and south-east of the Fair Isle Channel on a research cruise. In the meantime, however, large numbers of small solitary forms had become established on T and by September *S. fusiformis* had reached the A route and the western end of K. *Thalia democratica* were well represented in the high average figures for salps found in August and September on H but although this species reached W and X in September it could not be traced further north. *Doliolum gegenbauri* were also plentiful on the Atlantic records from June to August; they reached as far north as 60°, but were not found through the Faroe-Shetland Channel. *D. nationalis* were common as well on H in the autumn and

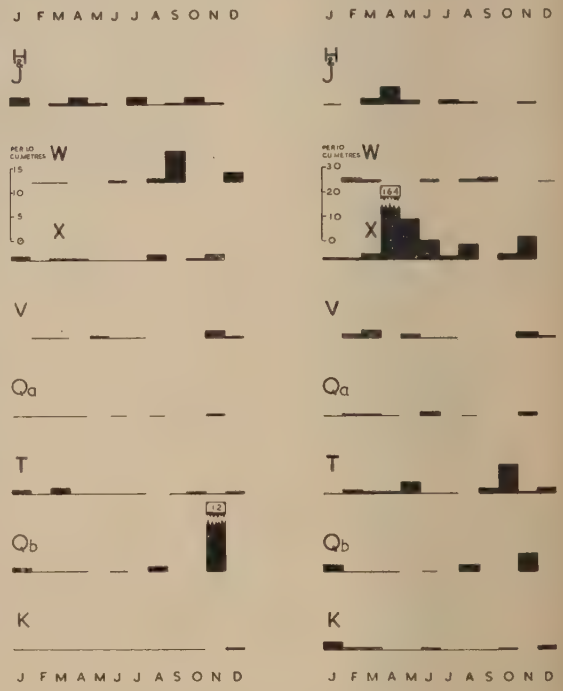


Figure 40. Histograms representing the relative numbers of *Euchaeta* spp. taken month by month from the Recorder routes H & J, W, X, V, Qa, T, Qb, and K. Only that part of the tow taken outside the 100-fathom contour is included on routes H & J, W, X, V, and T; otherwise details as in Figure 37.

Figure 41. Histograms representing the relative numbers of *Metridia lucens* taken month by month from the Recorder routes H & J, W, X, V, Qa, T, Qb, and K. Only that part of the tow taken outside the 100-fathom contour is included on routes H & J, W, X, V, and T; otherwise details as in Figure 37.

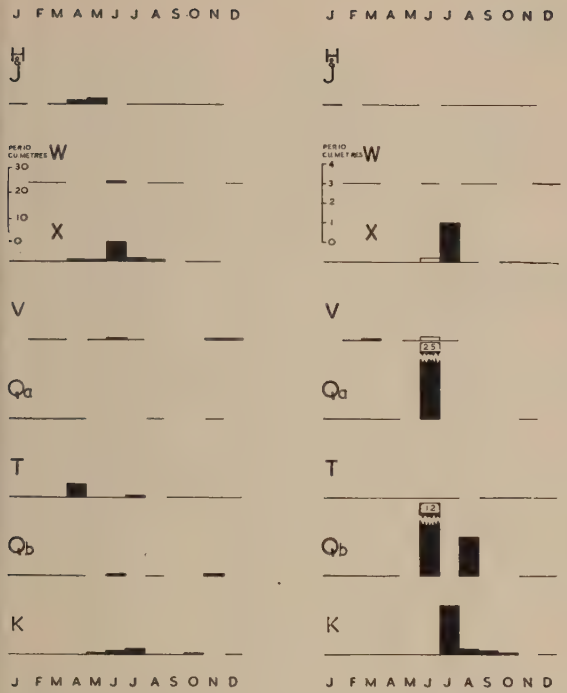


Figure 42. Histograms representing the relative numbers of *Limacina* (only those individuals larger than 1 mm. included) taken month by month from the Recorder routes H & J, W, X, V, Qa, T, Qb, and K. Only that part of the tow taken outside the 100-fathom contour is included on routes H & J, W, X, V, and T; otherwise details as in Figure 37.

Figure 43. Histograms representing the relative numbers of *Clione* (black) and *Clio* (open) taken month by month on the Recorder routes H & J, W, X, V, Qa, T, Qb, and K. Only that part of the tow taken outside the 100-fathom contour is included on routes H & J, W, X, V, and T; otherwise details as in Figure 37.

although they did not appear to progress far north, they extended well over the Shelf and into the Celtic Sea by September.

Rhincalanus nasutus was again scarce, captures being restricted to a few specimens on W in June and August, X in March and April, and V in May.

As far as one can deduce from a preliminary review based on the summarized distribution of these few selected animals, 1955 was characterized by the general paucity of plankton; the salps and doliolids being the only exception to such a generalisation. Possibly because the catches of most species were so low, there was little indication of the time succession from the southern Atlantic routes northwards to the Norwegian Sea and into the North Sea which we have come to expect as normal but here again the *Thaliacea* were the exception. The occurrence of *Metridia* on K from January to March and of *Tomopteris* and *Euchaeta* on K in January would suggest some carry-over of the previous autumn conditions. The appearance of *Limacina* over the Fisher Bank from May to July in company with *Metridia* in June and big numbers of young *Clione* in July would indicate a mid-summer thrust from the Atlantic directed well towards the east. It was not until September that *S. fusiformis* or until October that *Metridia* reached the region off the Forth which is more usually influenced by the main autumn influx of plankton; though the latter instance may not be significant in view of the general scarcity of *Metridia* elsewhere.

K. M. Rae

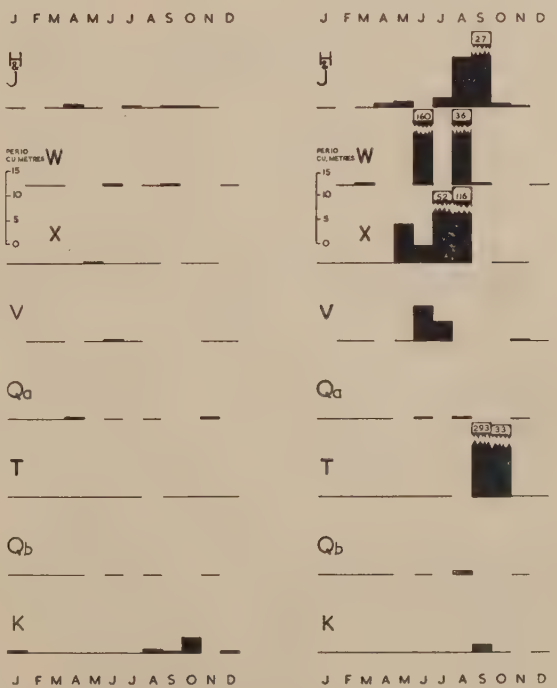


Figure 44. Histograms representing the relative numbers of *Tomopteris* taken month by month on Recorder routes H & J, W, X, V, Qa, T, Qb, and K. Only that part of the tow taken outside the 100-fathom contour is included on routes H & J, W, X, V, and T; otherwise details as in Figure 37.

Figure 45. Histograms representing the relative numbers of *Thaliacea* taken month by month on Recorder routes H & J, W, X, V, Qa, T, Qb, and K. Only that part of the tow taken outside the 100-fathom contour is included on routes H & J, W, X, V, and T; otherwise details as in Figure 37.

Benthonic Food

Investigations of the Bottom Fauna

(Tables 8 and 9)

The qualitative and quantitative bottom fauna investigations in the eastern part of the German Bight were continued in 1955. In spring 31 grab samples were taken at 16 stations and in autumn 45 samples were taken at 21 stations. An apparently good spatfall in 1954 and the stable weather situation in the summer and autumn of 1955 afforded very favourable conditions for the development of the bottom fauna stock in the area investigated. These circumstances resulted in an increase of the stock of lamellibranchs and polychaetes. The animals which feed on detritus showed an extraordinarily strong propagation. This was caused by an exceptionally strong and steady sedimentation of detritus during calm weather. In the lamellibranchs the species with long siphones (*Angulus* and *Abra*), in the polychaetes especially the sedentary tubicoles, and in the echinoderms *Echinocardium cordatum* were strongly represented.

The stock numbers of lamellibranchs have nearly doubled in the spring and autumn of 1955 in comparison with 1954 (see Table 8). In this increase the following species were most prominent: *Angulus fabula*, the *Abra* species (especially *A. alba* and *A. nitida*), *Phaxas pellucidus* and *Spisula* (*Sp. solida* and *Sp. subtruncata*). The increase of the thin-shelled *Abra* species which were already observed in the autumn of 1954 became enlarged, and *Angulus fabula*, the stock of which had decreased remarkably, showed a higher abundance in the autumn of 1955 on all the stations concerned. The main proportion of the lamellibranch stock in the spring and autumn of 1955 (especially in *Angulus*) was young specimens, the adult specimens being very rare. Therefore, the volumes of the live stocks of the lamellibranchs did not show any increase in comparison with those of 1954, but a decrease.

In the polychaetes, *Pectinaria koreni*, *Spiophanes bombyx*, and *Magelona papillicornis* increased particularly strongly. Since also the polychaetes consist chiefly of younger specimens, the increase of the live stock in the spring and summer of 1955 is not so evident in comparison with the preceding year, as might have been expected according to the increase in numbers (see Table 9). The *Pectinaria* patches were very dense. In a single grab sample at an inshore station 567 specimens of *Pectinaria koreni* could be counted on 1/10 m.². The stocks of *Lanice conchilega*, *Spio filicornis*, and *Goniada bobrezkii* are somewhat smaller or equal to those of 1954.

The occurrence of *Capitella capitata*, a polychaete species, should be particularly noted as it has not till now been found in the area of investigation. In the autumn of 1955 up to 80 young *Capitella capitata* could be collected out of a 1/10 m.² sample.

In the gastropods, the steady decrease of the *Hydrobia* stocks before the Elbe Estuary is remarkable, *Lunatia nitida* having been found only in a few specimens near Helgoland.

The total stock numbers of the crustacea in the spring and autumn of 1955 were about equal to those of 1954. The chief proportion of the crustacea stocks is formed by the amphipods *Bathyporeia guilliamsoniana*, *Urothoë poseidonis*, and *Ampelisca brevicornis*.

The increase of the stock numbers in the echinoderms on the stations with sandy soil is mainly due to the occurrence of young *Echinocardium cordatum*. 95% of the Echinocardia in the grab samples of the autumn 1955 (32% in autumn 1954) are young specimens up to 10 mm. in lenght, more than half of which were below 3 mm. in length. These were probably born in summer 1955, and thrived well owing to the favourable weather and food conditions.

According to the bottom grab investigations in 1955 the presence of numerous bottom animals (especially lamellibranchs and polychaetes) in the

Table 8

	1949	1950		1951		1952		1953		1954		1955	
	Aut.	Spr.	Aut.	Spr.	Aut.	Spr.	Aut.	Spr.	Aut.	Spr.	Aut.	Spr.	Aut.
Lamellibranchs	50.6	27.3	139.4	102.1	71.1	44.7	53.8	51.5	62.7	17.3	27.6	30.4	52.9
Polychaetes	28.5	7.9	16.9	20.7	26.5	17.0	71.4	33.1	57.0	14.7	91.4	40.8	168.5
Crustacea	14.2	3.0	7.9	8.1	15.0	9.6	35.1	14.0	21.3	9.8	25.0	6.7	20.1
Echinoderms	8.8	2.9	10.1	12.8	12.4	9.6	11.0	5.8	13.0	3.4	9.0	4.9	32.3
of which *Echinocardium cordatum* .	5.0	1.0	4.9	5.1	4.2	2.8	4.1	2.6	3.2	1.2	1.8	1.0	17.6

Table 9

		1954 Spring	1954 Autumn	1955 Spring	1955 Autumn
Average numbers on $^1/_{10}$ m². at all stations	*Angulus*	10.5	11.5	13.5	17.5
	Abra	0.2	2.0	0.4	5.3
Percentage of young specimens	*Angulus*	8	18	31	63
(≦ 5 mm. length)	*Abra*	8	14	—	65
Average total stock on $^1/_{10}$ m². (biomass in cm³.) *Echinocardium cordatum* excepted		3.0	4.6	3.2	5.0
Average stock on $^1/_{10}$ m². (biomass in cm³.)	Lamellibranchs	1.8	2.0	1.9	1.6
	Polychaetes	0.7	2.2	1.1	2.5

eastern part of the German Bight might have led to expect this locality to be a very good "feeding ground". But, unfortunately, according to observations during the cruise in the spring of 1956 a great number of bottom animals, especially in the shallower areas, had been destroyed by the coldness of the winter of 1956.

E. Ziegelmeier

Food Investigations on Plaice

During the routine cruises with the R/V "Uthörn" in the spring and autumn of 1955, the stomach and gut contents of 166 and 286 plaice were investigated both quantitatively and qualitatively.

Owing to the presence of numerous young animals the stock of fish food was considerably larger in numbers, but only slightly larger in weight, in 1955 than in 1954, as appears from the bottom grab investigations.Probably the presence of the many young food animals influenced the feeding disposition of the plaice, and the average stomach and gut content of the plaice investigated in 1955 was less than that of the plaice in 1954:—

	1955 Spring	1955 Autumn	1954 Spring	1954 Autumn
cm³.	1.53	1.57	1.75	1.79

Contrary to the previous statement, according to which the plaice take mainly lamellibranchs in spring and polychaetes in autumn, it was found that already in the spring of 1954, the percentage of plaice containing polychaetes was larger than that containing lamellibranchs. This is in conformity with the composition of the food stock.

In the spring of 1955, the prevalence of the polychaetes was even more pronounced (see Ann. Biol., XI, p. 63, Tab. 18).

	1955 Spring	1955 Autumn
No. of plaice investigated	166	286
% containing lamellibranchs	67	68
% containing polychaetes	89	94

The polychaetes most frequently eaten by the plaice are *Pectinaria koreni*, *Lanice conchilega*, and *Spiophanes bombyx*.

The decrease of the *Lanice* stock, as appears from the bottom fauna investigations is reflected distinctly in the composition of the food taken by the plaice. While in the autumn of 1954 63% of the stomach and gut content investigated contained *Lanice* and 51% *Pectinaria*, in the autumn of 1955 the value for *Lanice* was only 36% and for *Pectinaria* 67%. While in the autumn of 1954 plaice stomachs and guts were filled with *Lanice*, the samples of the autumn of 1955 consisted of *Pectinaria koreni* only. *Spiophanes bombyx* was present in one third of the stomach and gut samples.

The following species of lamellibranchs were eaten chiefly in 1955:— *Angulus fabula*, *Phaxas pellucidus*, *Spisula*, and, again more frequently, both the *Abra* species (*A. alba* and *A. nitida*) as well as *Mactra stultorum*. While of *Angulus fabula* almost exclusively and of *Abra alba* partly large specimens were taken, of the other lamellibranch species (especially *Spisula* and *Mactra stultorum*) many young specimens could be identified in the stomachs and guts.

E. Ziegelmeier

THE FISH

Eggs and Larvae

Eggs and Larvae of Winter Spawners in the Southern North Sea (Figures 46-49)

In March 1955 the abundance and distribution of fish fry was investigated all over the southern North Sea on a combined cruise of the research vessels "Anton Dohrn", "Gauss", and "Uthörn". The figures show the distribution of eggs in the first and second half of March respectively (I or II).

The cold spell of February/March 1955 seems to have delayed the spawning of whiting and sprat so that next to no eggs of these species were found at the time of the cruise.

Eggs of plaice (Figs. 46 and 47) were found in large numbers during the first part of the cruise (8.—14. March) in the tongue of water in the central North Sea ($> 34.6^0/_{00}$ S) extending into the German Bight. Spawning must have occurred in these waters from about mid-February to mid-March and must have been very intensive in the last fortnight of February. In an area where

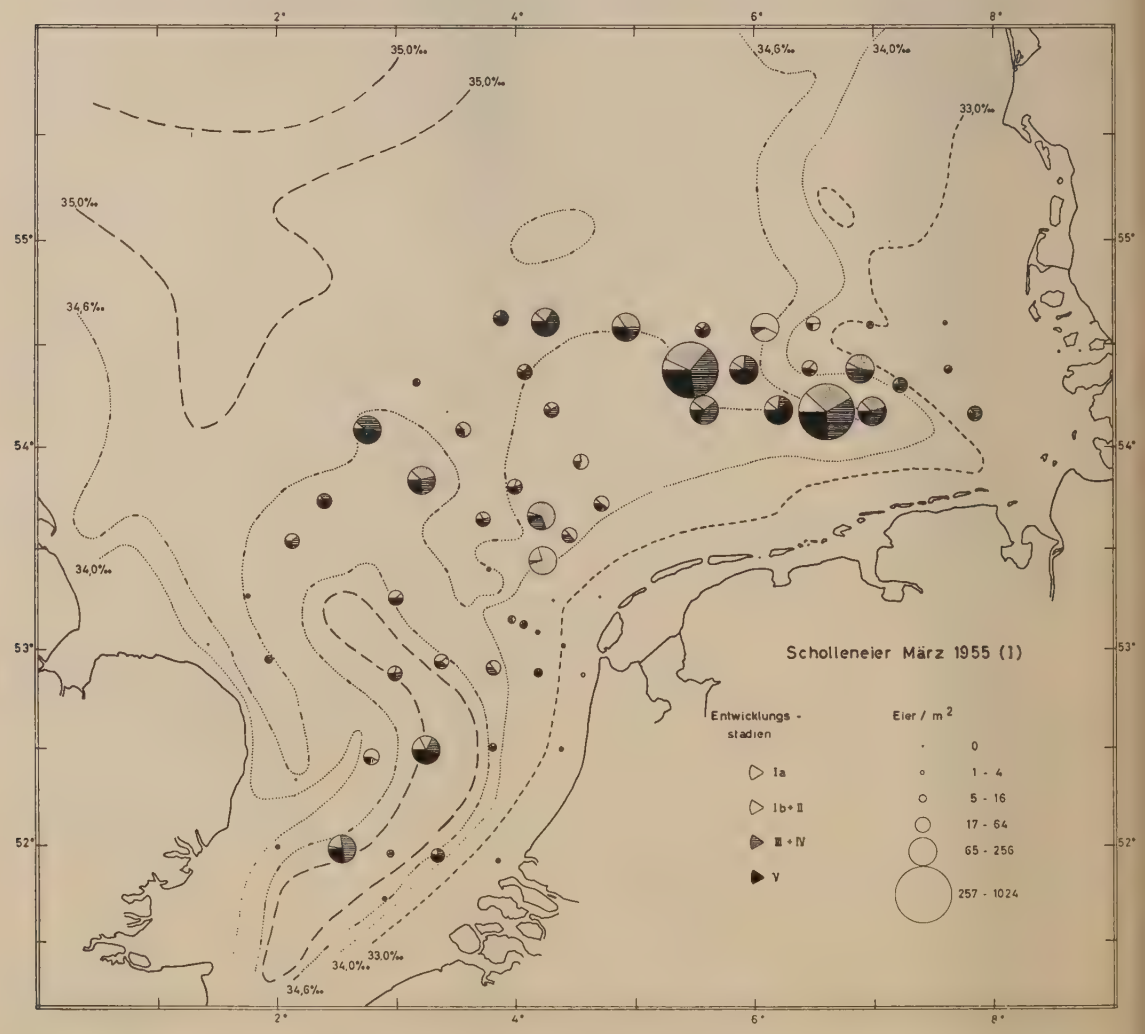


Figure 46.

plaice eggs were plentiful the mean catch per m.² was 200 and the maximum number of eggs found was 535.

Moderate to small numbers of eggs were caught all over the southern North Sea except in inshore waters. No striking differences were found in the developmental stages of these eggs and those from the German Bight. The spawning period of the plaice in the German Bight was prolonged and occurred rather late.

In the same area of the southern North Sea where plaice eggs were abundant cod eggs were found in large numbers, (Figs. 48 and 49) even in the area where central North Sea water was overlayered with colder and less saline inshore water. Eggs were present here in numbers unprecedented in the southern North Sea, with an average of 360 and a maximum of 2300 eggs per square metre (inside the area of stratification). The highest intensity of spawning must have occurred in the period 23. February— 3. March and spawning of medium intensity occurred in March in the White Bank area. In the Southern Bight, the Flamborough, and Botney Gut areas relatively few eggs and larvae were found. The cod spawning did not, however, occur later than usual, but was mainly concentrated in the south-eastern part of the area.

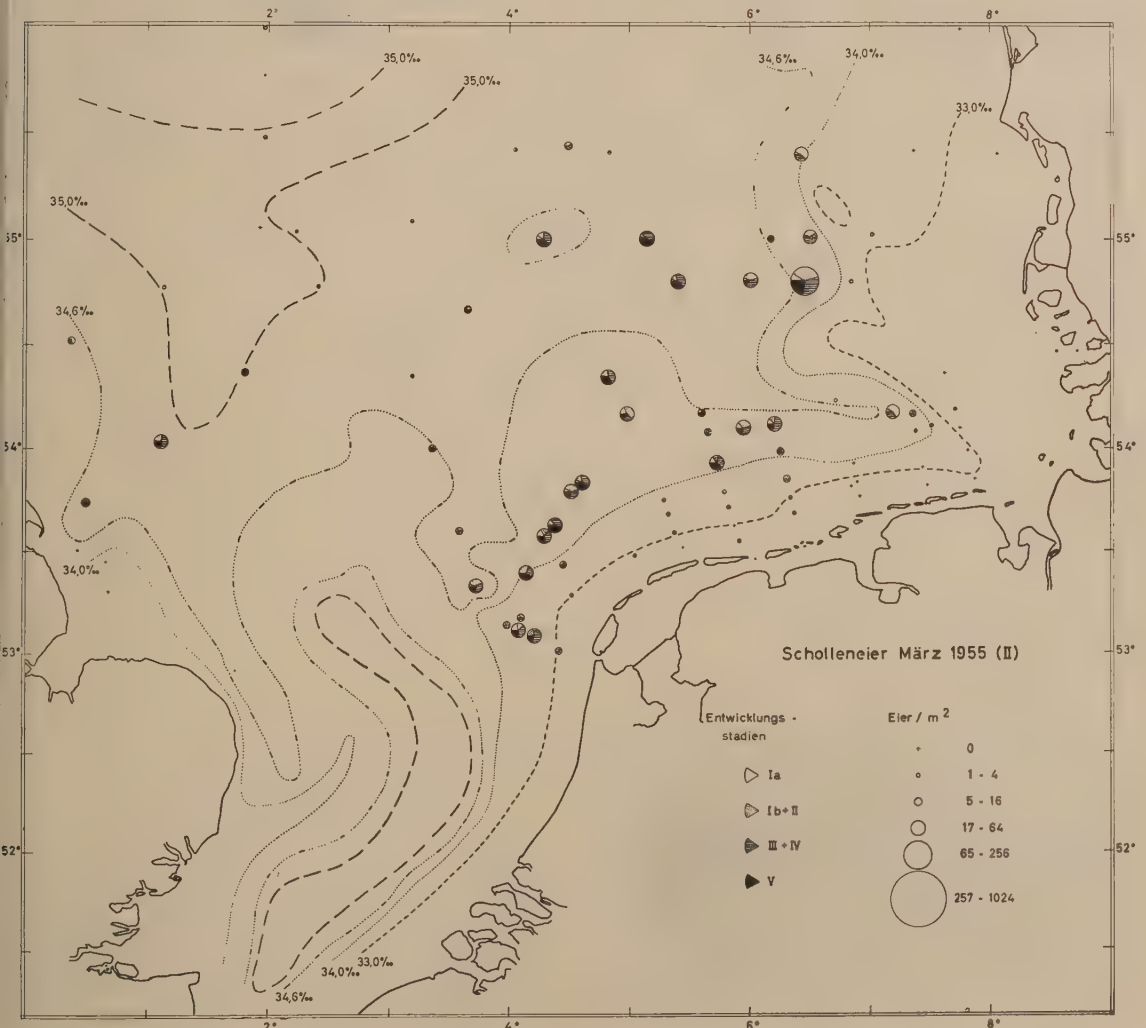


Figure 47.

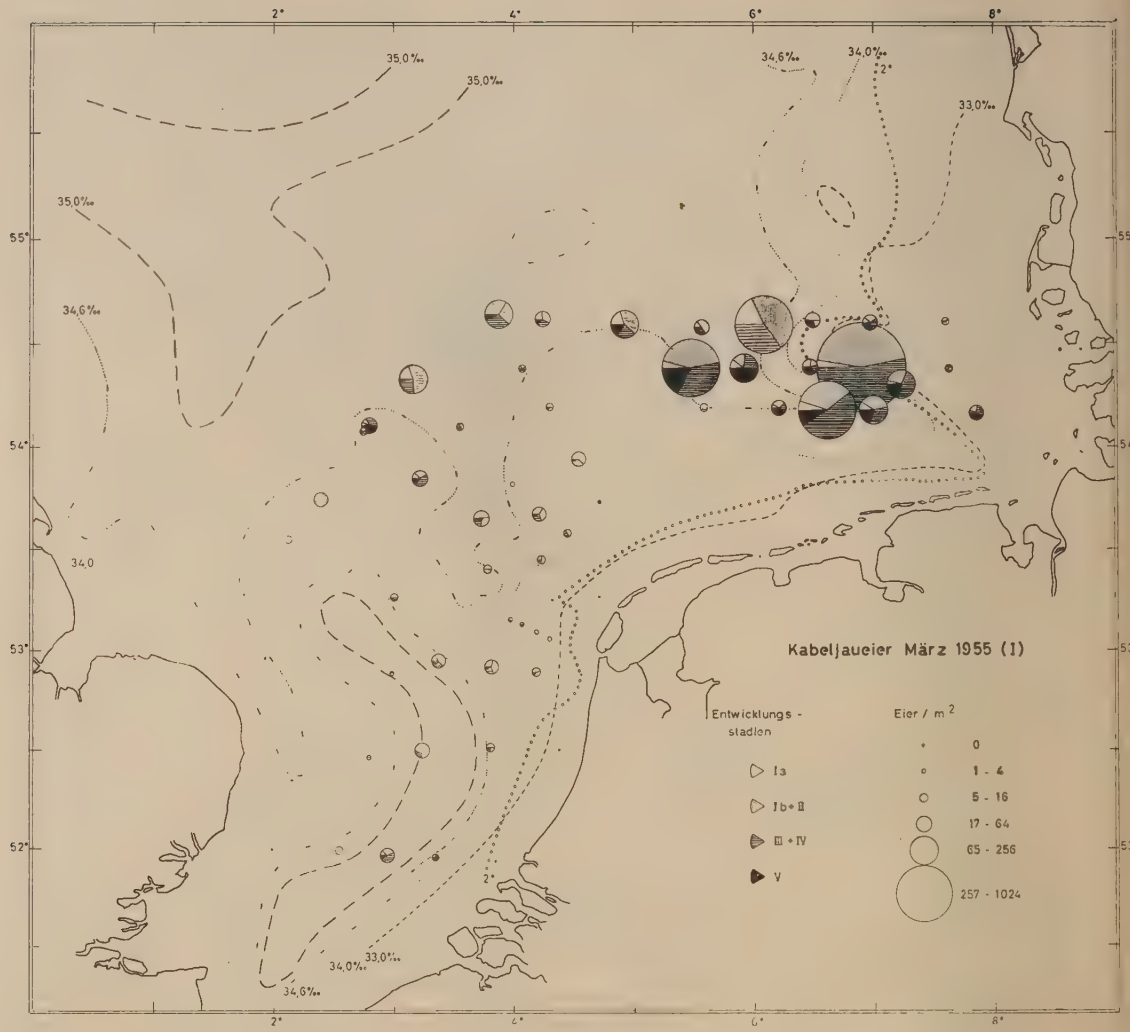


Figure 48.

It is doubtful whether the spawning of dab had already attained its maximum during the first part of the cruise, although dab eggs were very plentiful along the west to north Friesian coasts, the numbers here amounting to more than 500 eggs per square metre. West of Helgoland and off Texel the maximum numbers were above 5400 and 2800 eggs per square metre respectively. In the Dogger Bank area 3—400 eggs per m.² were ascertained.

A. Bückmann G. Hempel
Hj. Bohl J. Messtorff

Plaice

Young Plaice in Bridlington Bay

Ten hauls made in two fathoms of water using the same type of young-plaice trawl as is employed by the Danes off Esbjerg have been made each June since 1950. The hauls chosen are all daylight hauls and on each occasion they were made over a buoyed track off Bridlington South Sands at various states of the tide. The I-group was the dominant component of the population and the rate of capture per hour worked out at 50 in 1955.

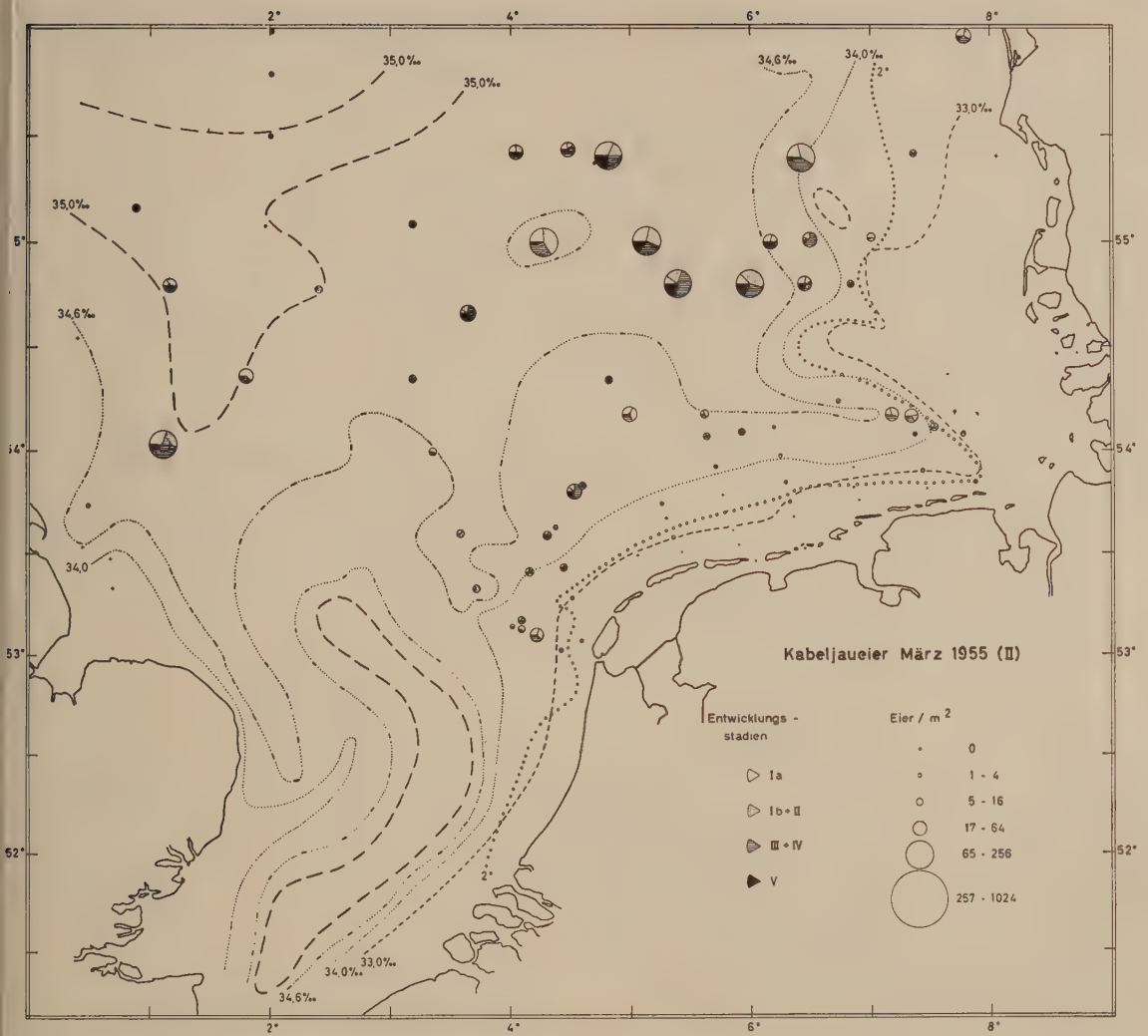


Figure 49.

In Table 10 I give the rate of capture per hour, as a weighted mean of 10 hauls each year, for the I-group of Bridlington Bay compared with the rate of capture per hour for O-group fish of the same birth year from the Danish Waddensea near Esbjerg (Ann. Biol. for 1950, 1951, and 1952) and the rate of capture per 100 hours fishing for the II-group fish of the same birth year landed by Lowestoft steam and motor trawlers (Ann. Biol. for 1953 and 1954).

Table 10

Birth-year	0-group per hour Esbjerg	I-group per hour Bridlington	II-group per 100 hours' fishing Lowestoft trawlers
1949	158	102	91
1950	382	213	142
1951	4	45	57
1952	302	275	162
1953	—	41	—
1954	—	50	—

It will be seen that, as far as the observations have gone, there is a certain correspondence in the relative strength of the year-classes measured at three different stages.

R. S. Wimpenny

Danish Plaice Investigations

1. Young plaice in the Danish Waddensea

Investigations with the young-fish trawl were carried out as usual on 21.—26. June, on 23.—27. August, and from 29. October to 1. November. A total of 112 hauls of 15 minutes duration was made.

In the northern area (Ho Bay—Knude Dyb) 72 hauls were made. The mean number per hour was 40 O-group plaice (1955 year-class) and 109 I-group plaice (1954 year-class). The mean for the years 1935—1955 is 207 O-group and 169 I-group plaice per hour. Thus, the number per hour obtained in 1955 is below the average for both age-groups. Few plaice were caught in the southern part of the Danish Waddensea (Juvre Deep—Højer Flak). The following numbers of plaice were caught per hour in the three years in which this area has been investigated:—

Year	Number of hauls	0-group	I-group
1953	46	70	47
1954	47	77	37
1955	40	12	55

2. The stock of plaice off Esbjerg (Table 11)

Trawling in the southern Horns Reef area was carried out from the M/C "Jens Væver" on 3.—6. June 1955. A 50 ft. otter-trawl with 9 mm. mesh in the cod-end was used. 15 hauls of 10 minutes and 14 hauls of 20 minutes duration were made. A large number of plaice was caught as compared with the number obtained during previous investigations in the period May—August. The numbers per hour were:—

	5—9 m.	10—29 m.
1934—39	—	374
1950	230	464
1951	929	215
1953	603	347
1954	314	42
1955	960	706

Age estimates (Table 11) show a predominance of the 1953 year-class (the II-group). KOTTHAUS (Ann. Biol., XI, p. 60) also observed a considerable strength of the 1953 year-class.

Plaice above the minimum size-limit (26 cm.) were scarce in the catches in 1955. 7.7 fish per hour were taken, 6.3 of which were III-group plaice while 1.4 were older. Thus, the commercial fishery in the southern Horns Reef area had to be based primarily on the biggest specimens belonging to the III-group.

Table 11. Age Distribution of Plaice from the Southern Horns Reef Area on 3.—6. June 1955, and in May—August of previous Years

(Numbers per hour)

	Age-group	I	II	III	IV	V+
Depth 5—9 m.	1950	69	83	89	2	—
	1951	216	419	135	168	7
	1953	432	77	89	5	0.3
	1954	256	58	0.3	—	—
	1955	236	682	42	—	—
Depth 10—29 m.	1934—39	132	150	53	14	27
	1950	25	109	284	45	2
	1951	11	79	56	62	9
	1953	199	40	87	14	6
	1954	27	17	1	2	4
	1955	48	298	103	2	1

3. Landings of plaice at Esbjerg (Tables 12-13)

A size analysis of plaice landed at Esbjerg has been attempted, based on the percentage weight distribution such as it appears from the amount of plaice of each size category on the fish market. The categories are:—

0 = more than 1000 g.
1 = 500—1000 g.
2 = 375— 500 g.
3 = 250— 375 g.
4 = less than 250 g.

The landings may be divided into two groups: one dominated by category 4 and another dominated by category 1 (cf. Table 12). In 12 landings the number of plaice occurring in 10—35 kg. of each category were counted. The mean weight within each category was:—

	Landings dominated by category 4		Landings dominated by category 1		
Cat.	Nos.	Mean weight g.	Nos.	Mean weight g.	P
0	3	1254 ± 559	5	1437 ± 151	>0.10
1	7	579 ± 69	5	679 ± 64	0.05—0.01
2	7	441 ± 42	5	476 ± 59	>0.10
3	7	314 ± 25	5	354 ± 49	0.10—0.05
4	7	215 ± 11	5	248 ± 44	0.05—0.01

The 95% confidence limit of the mean is shown. "P" gives the probability level as indicated by a *t*-test.

249 landings have been investigated as to fishing locality and depth. Table 12 shows the percentage of the total weight landed of each category. A mean weight of plaice has been estimated, based on the mean weights of specimens within each category, as shown above. Landings consisting mainly of small plaice (mean weight about 240 g.),

Table 12. 249 Landings of Plaice from the North Sea in 1955

(For interpretation of weight categories, see text)

Region	No. of landings	Period	Depth (fath.)	Weight distribution, % Cat. 4	Cat. 3	Cat. 2	Cat. 1	Cat. 0	Total	Estimated mean weight, g.
Horns Reef	8	29. 4.–2. 5.	8—15	90	9	1	–	–	100	222
—	24	1.–9. 6.	4— 9	79	19	2	–	–	100	231
—	19	—	10—14	49	35	13	4	–	101	269
—	9	27. 6.–2. 7.	4— 9	86	14	1	–	–	101	226
—	12	—	10—14	78	19	2	–	–	99	231
—	3	—	15—19	56	28	13	4	–	101	262
—	16	29. 8.–3. 9.	10—14	84	14	2	–	–	100	227
—	11	—	15—19	77	20	3	–	–	100	233
—	12	3.–9. 11.	10—14	87	11	2	–	–	100	225
—	10	—	15—19	73	23	4	1	–	101	238
—	1	—	20	58	35	6	1	–	100	252
Horns Reef total	125	April–Nov.	4—20	75	20	4	1	–	100	236
E.R. Lightship (off Horns Reef)	1	1.–9. 6.	16	3	25	22	35	14	99	518
German Bight	5	29. 8.–3. 9.	10—14	37	34	19	10	–	100	294
Mud Hole – Clay Deep	4	1.–9. 6.	16—24	66	28	4	2	–	100	245
Holland – Clay Deep	2	27. 6.–2. 7.	10—14	67	25	6	1	–	99	243
—	14	—	15—19	74	20	4	2	–	100	238
—	19	—	20—24	68	26	4	2	–	100	243
—	4	—	25—29	56	32	8	3	–	99	257
—	4	29. 8.–3. 9.	10—14	48	28	12	11	1	100	279
—	14	—	15—19	55	27	9	7	1	99	264
—	4	—	20—24	59	26	8	6	2	101	261
—	1	—	25	74	23	3	1		101	238
Mud Hole–Holland–Clay Deep (total)	66	June–Sept.	10—25	64	25	6	4	1	100	242
Dogger Bank area	6	29. 4.–2. 5.	?	20	19	15	28	19	101	459
—	10	1.–9. 6.	10—25	11	16	13	37	23	100	538
—	3	27. 6.–2. 7.	16—22	1	8	15	57	19	100	641
—	10	29. 8.–3. 9.	16—25	8	24	25	37	7	101	476
—	9	3.–9. 11.	10—20	1	6	17	52	24	100	662
Dogger Bank area (total)	38	April–Nov.	10—25	8	15	17	41	18	99	541
N. of Dogger Bank	5	1.–9. 6.	22—45	3	7	17	41	31	99	660
—	9	27. 6.–2. 7.	22—50	1	9	17	58	15	100	621
Total	14	June–July	22—50	2	8	17	52	21	100	629

originated from the southern and eastern North Sea. Landings of large plaice (mean weight about 600 g.) originated from the Dogger Bank area and from the northern North Sea. A single landing dominated by large plaice (mean 518 g.) came from off Horns Reef in June. This occurrence seems rather isolated.

The estimated percentage age distribution in 12 landings is shown in Table 13. From each landing 10—35 kg. of plaice were otolithed within each size category. The total number of fish otolithed is 2127 (138—202 per landing). The mean age of the fish, counting full years only (i. e. "the mean age-group") is also estimated. In areas where small plaice, landed as category 4, were predominant the 1952 year-class is the most important one (the III-group), particularly in the Horns Reef area in which it seems to have amounted to 75% of the number of marketable plaice. In landings dominated (by weight) by large plaice landed as category 1 the 1950 year-class (the V-group) is the most abundant one. The landing from the German Bight which, despite the low mean weight of the plaice (294 g.), consists of very old fish, particularly the 1947 year-class (the VIII-group) seconded by the 1950 year-class is exceptional.

Erik Ursin

Table 13. Percentage Age Distribution of Plaice in 12 Landings from the North Sea in 1955

Region	Period	Depth (fath.)	1953 II	1952 III	1951 IV	1950 V	1949 VI	1948 VII	1947 VIII	1946 IX	1945–41 X-XIV	1940–36 XV-XIX	Total	Mean age-group
Horns Reef	1.–9. 6.	10	–	**66**	18	13	1	1	1	–	–	–	100	3.6
—	—	12–14	2	**78**	16	4	–	–	–	–	–	–	100	3.2
—	29. 8.–3. 9.	14–18	–	**81**	10	8	1	–	–	–	–	–	100	3.3
Horns Reef (total)	June–Sept.	10–18	1	**75**	15	8	1	–	–	–	–	–	100	3.3
E.R. Lightship (off Horns Reef)	1.–9. 6.	16	–	18	19	**27**	14	2	12	3	4	1	100	5.5
German Bight ..	29. 8.–3. 9.	13–14	–	4	9	21	18	12	**23**	7	7	–	100	6.7
Mud Hole	1.–9. 6.	18–22	–	**29**	28	28	9	3	3	–	–	–	100	4.4
N. of West Hole	29. 8.–3. 9.	16	–	**34**	23	26	5	7	3	1	2	–	101	4.6
Clay Deep	—	23–25	–	**40**	32	19	7	–	2	–	–	–	100	4.0
Clay Deep–West Hole (total) ...	June–Sept.	16–25	–	**34**	28	25	7	3	2	–	1	–	100	4.3
Dogger Bank ...	1.–9. 6.	12	–	9	14	**31**	12	11	12	4	4	3	100	6.2
—	—	11–14	–	7	18	**23**	15	8	13	6	7	2	99	6.4
S. of Tail End...	29. 8.–3. 9.	24–26	–	13	30	**36**	10	6	4	1	–	–	100	4.8
—	—	24–25	–	7	24	**34**	16	9	8	1	1	–	100	5.3
Dogger Bank area (total)....	June–Sept.	11–26	–	9	22	**31**	13	9	9	3	3	1	100	5.6

Plaice in the Skagerak-Kattegat Area

1. Coastal investigations, 0- and I-group (Table 14)

The number of 0-group **plaice** caught per hour with a Johansen young-plaice trawl was investigated in July-August, but the wind was north-easterly when the M/B "Havkatten" was fishing in northern, and, more particularly, also in central Kattegat, and although fishing was carried out on the most favourable days there was 10—15 cm. high waves at the coast and therefore the number of fish caught was much too low.

For this reason the fishing was repeated when there was an opportunity in October, but this was rather too late in the season because the young plaice and flounder were leaving the coastal waters so that figures found from these stations are somewhat low.

Table 14 shows that the 1955 year-class was normal or slightly below the normal in northern Kattegat. In central Kattegat it seems to have been somewhat lower than normal, but in southern Kattegat it was very much stronger than normal at the Danish coasts.

In Skelderviken-Laholm Bay, the Swedish southern Kattegat coast, the "Havkatten" was allowed to carry out coastal investigations, because the Swedish fishery investigations were not able to undertake this kind of research. This region has often shown fluctuations different from those at the Danish coasts, and in several years a very much larger amount of 0-group plaice has been found here than at the Danish southern Kattegat coasts. Therefore investigations of this coast is of particularly great importance for predicting the stock of older plaice in southern Kattegat.

Table 14. Numbers of Plaice and Flounder caught per Hour at Coastal Stations

(In brackets mean for 1905—54 and 1929—38 on the Danish and Swedish coasts respectively)

Locality	Date	Number of stations	Plaice 0-group		Plaice I-group		Flounder 0-group
N. Kattegat	July	10	>33	(80)	>7	(52)	0
N. Kattegat	October	10	>45	—	40	—	0
Ctr. Kattegat.....	July—August	18	>10	(39)	0.6	(12)	10
Ctr. Kattegat.....	October	11	>13	—	2	—	7
S. Kattegat, Danish	August	15	95	(16)	3	(2)	0
S. Kattegat, Swedish	August	20	116[1])	(192)	0.2[1])	—	300[1])

[1]) Approximate figures.

The examinations of the material from this fishery are is not completed, but the preliminary results seem to show that the density of the 0-group here was only somewhat above 50% of the normal figures.

In July the number of I-group plaice at the coast was very small in northern Kattegat, but in October it was slightly below the normal, indicating that a considerable immigration from the Skagerak coast must have taken place after fishing in northern Kattegat ended in July 1954, when only a small number of 0-group plaice was found there. In central Kattegat the numbers of I-group plaice were considerably below normal. In southern Kattegat the growth of young plaice is so rapid that very few I-group fish are found at the coasts, and the numbers found are therefore a very poor indicator of the strength of the year-class.

The number of 0-group **flounder** caught per hour in central Kattegat is normally about 1 but in both 1954 and 1955 it was much above the normal figure. At the sandy Danish coasts of southern Kattegat no flounders were found by coastal fishing, but in Laholm Bay and Skelderviken the catch was very large especially at some stations for which examination of the material is not yet completed.

In 1955 the numbers of **turbot** and **brill** in the Kattegat seems to have been slightly above the normal.

The numbers of 0-group sole were considerably above the normal at all Danish coasts of the Kattegat.

2. The stock of plaice in the Skagerak-Kattegat

Quantitative fishing (Tables 15 and 16)

The average numbers of the various age-groups caught in November are shown in Table 15. The number of stations is very small for some depth-zones, and it is not quite sufficient for the others, so that only approximate density and distribution are given.

Table 15. Number of Plaice caught per Hour at various Depths in November 1955

Depth-zone m.	No. of stations	Age-group I	II	III	IV	Total
Skagerak						
11— 25.....	5	4	6	3	—	13
55— 89.....	4	3	5	1	—	9
98—104.....	2	—	1	—	—	1
Northern Kattegat						
10—14.....	2	36	94	4	—	134
15—34.....	6	19	20	1	1	41
>35.....	8	1	4	1	—	6

Table 16. Length Distribution of Plaice per 5 Hours Fishing from the "Biologen" in Northern Kattegat in 1955

Length cm.	June 15—28 m.	June 41—70 m.	November 11—30 m.	November 35—51 m.
10—11....	4	—	—	—
12—13....	8	—	3	—
14—15....	6	—	8	—
16—17....	14	—	20	6
18.....	10	—	16	2
19.....	18	—	28	—
20.....	28	—	21	2
21.....	48	—	19	—
22.....	38	—	18	2
23.....	34	—	41	6
24.....	30	—	46	4
25.....	56	—	42	4
26.....	32	—	29	—
27.....	30	—	9	4
28.....	14	—	9	—
29—30....	10	2	10	6
31—32....	4	2	0	6
33—34....	0	—	1	6
35—36....	2	—	1	2
37—38....	—	—	—	2

The investigation in the Skagerak covered the bay between Skagen and Hirtshals and the region off Hirtshals and north of Skagen. It appears from the table that the percentage age distribution in November was the same in this part of the Skagerak as in northern Kattegat (the Hertha Flak region between Skagen-Frederikshavn-Læsø). Most of the plaice were II-group fish. The I-group (1954 year-class) averaged 20 cm. in length, but a considerable proportion was found at the coast as late as October in the catches by the Johansen young-plaice trawl and the 1954 year-class may possibly be stronger than the 1953-class as the coastal fishing investigations in northern Kattegat showed.

A very great change in the age composition had taken place in northern Kattegat between the investigations of June and November. The preliminary age determinations available from June are too indefinite to allow of a comparison, but the length distributions (Table 16) show clearly that in June the III-group (26 cm. length) was almost as frequent as the II-group (22 cm. length), whereas in November the III-group was only about 5% of the number of the II-group; the number of I-group plaice was 50% of that of the II-group. The rise in the numbers of I-group plaice originated of course from depths of less than 10 m., but at the coast this year-class was proportionately rare in August, and a great increase in their numbers there, as stated in October, must be due to an immigration from the Skagerak. A very considerable immigration of I-group plaice from the Skagerak to northern Katte-

gat took place between June and November, even at depths up to about 30 m. The enormous decrease of III-group plaice is of course due to the toll taken by the fishery. It is worth noting that in both June and November the steep decrease in the number of plaice take effect just above the Danish size-limit. Numerous plaice of the III-group must, by November, have been removed from the stock found in June. The comparison stresses that the lengths of age-groups found from the quantitative fishing give erroneous figures for the growth, a fact which is very often forgotten.

The total stock in northern Kattegat was of similar quantity as in previous years and very much lower than in the '30ies.

In central and southern Kattegat the density of the stock was very small in depths of more than 15 m. The extent of fishing at depths below 15 m. was not sufficient to give any indication of the density there.

The few plaice caught in central and southern Kattegat were 19—42 cm. long. Four-fifth of them were more than 30 cm. long and most of these fish belonged to age-group III, the rich 1952 year-class. Fishing in this region is not very intensive, and a rather large proportion of the stock may attain a considerable length.

3. Commercial catches of plaice in Skagerak-Kattegat
(Table 17)

Table 17 shows the length analyses of commercial catches taken near Skagen in February and March 1955 and a comparison with analyses from the same localities in the same months of 1950—51. It will be seen that the plaice caught in 1955 were smaller than those of previous years. The reason is that, in 1955, a strong year-class was recruiting the stock of commercial plaice while there was no such recruitment in 1950 or 1951. Age analysis of the catch taken south of Skagen in February 1955 (Table 17) proved that 84% of these plaice were II-group fish, i. e., from the year-class of 1952.

The average number of anal fin rays was 54.0 and thus showing that these plaice belonged to the North Sea race. This is a frequent experience in these waters.

Table 17. Length Composition of Plaice (%) from Commercial Catches in the Skagerak and in the Kattegat (Danish Seine and Trawl)

Locality/Date	Depth, m.	Number of samples	Length, cm. 26—30	31—35	36—40	41—45	46—50	Mean
N. of Skagen								
1950, February—March	13—33	9	43	41	13	3	0.2	32.2
1951, March	35	1	49	43	7	1	—	31.4
1955, February—March	23—24	2	71	27	2	1	—	29.4
N. of Skagen								
1950, February—March	37—56	3	22	59	17	2	—	33.3
1951, March	45—75	2	26	51	19	4	—	33.8
1955, February—March	38—56	4	51	38	10	1	—	31.3
S. of Skagen								
1950, February	9	1	41	47	9	1	—	31.7
1951, February	19	1	60	35	5	—	—	30.5
1955, February	21	–	69	27	4	—	—	30.2
N.E. of Fornaes (S.W. Kattegat)								
1952, February—March	18	2	43	43	13	1	—	31.8
1955, February—April	17—19	4	41	48	10	1	—	31.8
E. of Jernhatten								
1952, February—March	20—21	2	48	39	12	2	—	32.0
1955, March—April	17—23	2	41	40	17	2	—	31.9
Aalborg Bay								
1951, October	11—13	3	63	33	3	—	—	30.3
1955, October	11—17	3	58	35	6	1	—	31.0
1955, December	13	1	18	47	35	—	—	34.3
S. and S.S.E. of Anholt								
1951, October—November	23—30	2	30	41	27	2	—	33.2
1955, November	27—33	2	24	42	28	6	—	34.1
At Briseis Flak (S.W. Kattegat)								
1951, October—December	21—22	3	27	51	17	4	—	33.3
1955, October—December	20—27	3	27	48	23	2	—	33.3

In the southern Kattegat length composition of plaice caught in February—April 1955 was almost the same as in the same months of 1952; in both years plaice of 26—30 and 31—35 cm. length made out 40—50% of the catches. In both years recruitment to the commercial stock came from good year-classes. In 1955 the very strong 1952 year-class was predominant in the stock of commercial plaice and gave rise to extraordinary large fisheries in the region of Schultz's Grund—Briseis Flak. Length measurements of the unsorted plaice of two catches showed that the average length there in February 1955 was about 1 cm. lower than in February 1952. Also here an analysis of the sample from 1955 showed that about 75% of the catch were of the 1952 year-class.

In the autumn of 1955 the length composition of the commercial catches was nearly equal to that of the autumn of 1951, both in Aalborg Bay and southern Kattegat (see Table 17). In the course of the summer of 1955 the main proportion of the rich 1952 year-class had been fished, but yet it dominated the stock of commercial plaice in southern Kattegat, and the average length had increased 2 or 3 cm. In Aalborg Bay there seems to have been an immigration, about November, of these large, almost four-year-old fish, from the southernmost Kattegat where this year-class had been more abundant than in central Kattegat; the average length in a catch there from December was 3 cm. higher than in catches from October—November.

The remainder of the rich 1952 year-class will surely appear to be greatly reduced in numbers in 1956 and the yield of the fishery must decline.

Aa. J. C. Jensen

4. The Limfjord stock of plaice

Investigations were carried out in March, July, and November; the following gears were used: eel-tog, cod trawl, and eel trawl. The numbers obtained per 1 hour's fishing were as follows (in brackets average eel-tog numbers for 1927—52):—

	Nissum Broad		Thisted Broad		
	Eel-tog	Cod trawl	Eel trawl	Cod trawl	Eel-tog
July ..	8.3 (658)	95	38.1	118	(13)
Nov. ..	—	77	—	17	—

Because of the cold weather in the spring the plaice did not enter the Nissum Broad (western part of the Limfjord) until the first half of April. Towards the end of May the stock left the area again, a fact which is clearly demonstrated through the increased difficulties in getting sufficient quantities of plaice for the transplantation. During the regular investigations in July the catches of plaice were small in Nissum Broad. Later in the summer, however, a considerable immigration took place giving rise to a profitable fishery—the largest for many years.

In Thisted Broad the catches were very much above the normal, probably caused by the very large quantities of fish transplanted in 1955.

The following table gives a survey of the age composition of plaice from Nissum Broad (in %):—

Age-group	Year-class	March	July	November
0	1955	0	0	0
I	1954	0	8	0
II.....	1953	88	36	35
III	1952	12	59	49
IV	1951	0	3	14
V	1950	0	0	1
VI	1949	0	0	1

It appears that while in March the II-group was dominant the III-group formed the majority in July and November, small quantities of older fish (IV+) being added to the stock in the autumn.

O. Bagge

5. Transplantation of plaice to the Limfjord

In April and May 1955 a total of 194,000 kg. or 2,552,700 specimens were transplanted from Nissum Broad to the inner broads of the Limfjord; Thisted Broad, 148,000 kg., Løgstør-Hannæs Broad, 44,000 kg., and Hjarbæk Fjord, 2,000 kg. Like the Belt Sea transplantation all the plaice were transported in well-smacks.

Examinations of the plaice for average length and weight and age compositions gave almost the same result as in 1954. The figures for 1955 in comparison with those for 1954 and 1953 were as follows:—

Year	Average length, cm.	Average weight, g.	Age composition (%) II-group	III-group
1955	19	76	58—38	15—12
1954.....	19.5	72	85	14
1953.....	22.1	110	14	85

A total of 600 plaice were tagged with the Petersen disks, 1600 with the roll-tag and 550 were tattooed and tagged with a subcutaneous tag.

The liberations in Thisted Broad may be divided into four periods according to the water temperature. From one load in each of these periods 100 plaice were tagged with Petersen disks and 200 with roll-tags:—

Date	Average temp. of water, °C.	Kg. plaice transpl.	Recaptures up to 31. December (%) Petersen disks	Roll-tags
15.–21. April	4.1	40,000	82	49
22.–28. April	6.5	36,000	67	36
29. April–23. May	8.1	48,000	26	15
24.–26. May	9.1	24,000	35	12

The percentages of recaptures show a distinct decrease with increasing temperature. The recaptures in the first period were good, in the second period less satisfactory, and in the third and the fourth period completely unsatisfactory.

In 1955 the cost of the transplantation to Thisted Broad was equivalent to the value of 35 tons marketable plaice. According to the fishery statistics 39 tons were caught at the end of this year. The calculated recapture percentage by weight at the same time was about 29%, corresponding to 42 tons.

As no special fishery statistics are made for Løgstør-Hannæs Broads, the results of the transplantation to this area must be judged by recaptures only. The recapture percentage by weight at the end of 1955 was 35%. The calculated quantity of marketable fish recaptured was 16 tons; 11 tons were necessary to pay the costs.

In one of the experiments on the effect of transport on the mortality after liberation 200 tagged plaice were transported covered with sand in boxes placed under the surface of the water in the well in a well-smack. This experiment gave no better result than an experiment, carried out at the same time, with plaice transported in the usual way.

To examine the effect of the reloading of the plaice from a well-cutter via well-boxes to well-smacks, some plaice were loaded in well-smacks directly from the seines of the cutters. Tagging of these fish gave slightly better results than those obtained from plaice taken at the same time but reloaded in the usual way.

O. Bagge, E. Bertelsen

Dab

1. Dab in the Southern North Sea

Investigations on the dab stock, which were started during the summer and autumn of 1954 at the North Friesian coast (see Bohl, Ann. Biol., XI, p. 67), were continued in March 1955. During a cruise of the research vessel "Anton Dohrn" 7 hauls with the cutter trawl and 15 hauls with the herring trawl were made in the area of Vlieland Riff—Outer Silver Pit—Clay Deep—Tail End—White Bank—Horns Reef—Oyster Ground.

The following percentage age composition of the stock was ascertained:—

Age-group	Cutter trawl	Herring trawl
0	—	1.3
I	2.4	19.1
II	13.7	22.8
III	26.3	24.6
IV	29.3	19.4
V	15.7	8.6
VI	8.3	3.1
VII	4.0	1.0
VIII	0.3	0.1
	100.0%	100.0%

A comparison between the age composition of the North Friesian coast stock and the southern North Sea stock of dabs shows no definite difference in age composition.

The rate of growth of dabs in the southern North Sea is somewhat higher than in the coastal area. 2862 otoliths were examined. The average lengths in cm. of the age-groups were as follows:—

Age-group	Females	Males	Total
0	8.9	8.6	8.8
I	14.0	13.4	13.7
II	16.9	15.7	16.3
III	18.9	17.2	17.9
IV	20.7	18.6	19.7
V	23.0	20.0	21.5
VI	24.6	21.2	22.9
VII	—	22.5	—

Hj. Bohl

2. Dab in the Kattegat

The number of dabs obtained per 1 hour's fishing with the cod trawl from the S/S "Biologen" will appear from the following (number of hauls in brackets):—

	1955	1954
N. Kattegat	184 (22)	184
C. Kattegat	71 (7)	38
S. Kattegat	42 (4)	175

It appears that in northern Kattegat the number obtained was exactly equal to that of 1954. In the remaining area the number of hauls was too small to allow of any comparison. As was the case in the previous years the catches were greatly dominated by young fish (I- and II-group).

J. Knudsen

3. The Limfjord stock of dabs

As in the two previous years the stock of dabs was very small in 1955 and the numbers taken per 1 hour's fishing with the eel-tog and the cod trawl in Nissum Broad were as follows:—

	Eel-tog			Cod trawl
			Average for	
	1954	1955	1927—52	1955
July	18	0.8	78	8.2

The numbers found in 1955 seem to be the smallest observed since 1927.

During the investigations in March no dabs at all were present. The remaining area of the Limfjord had a very small stock of dabs, the only exception being Thisted Broad, where 8.4 dabs were obtained in July per 1 hour's fishing with the cod trawl. Probably the existence of dabs in this area may be ascribed to an accidental inclusion of some dabs along with the plaice intended for transplantation.

O. Bagge

Eel

Prediction of the Yield in the Limfjord

In view of the summer temperatures a yield of the silver-eel fishery of about 25% over the normal was predicted. But according to the fishery statistics it was about 47% above the yield of 1954, when about 5% below the normal figure was expected.

The average for a series of years cannot be used as normal because the division in the statistics between the categories yellow and silver eels has changed in recent years. Moreover the size-limit for silver eel has been altered which no doubt caused more eels in the transition stage between yellow and silver eels to be sorted out as silver eels.

The tumour disease

At a whole this disease was somewhat less frequent in Danish waters than in 1954. In the Limfjord it has existed since 1952, and in some localities about 2—3% of the eels were infected.

Aa. J. C. Jensen

Sand-eel

A Danish Fishery for Sand-eel (Ammodytidae)

Since 1953 a fishery on sand-eels to the fish meal plants in Esbjerg has been carried out along the west coast of Jutland—mainly in the Horns Reef area.

A rapid increase of yield is shown by the following landing figures:—

1953: $4^1/_2$ mill. kg.
1954: 11 mill. kg.
1955: 34 mill. kg.

The fishery is confined to small patches and the admixture of other species in the landings is negligible. The fishing season cover the period May—July, June being the month of maximum effort and yield.

Three samples from commercial landings showed a similar composition of catch. *Ammodytes marinus* Raitt made up 94—$99^1/_2$% of the total numbers while *A. lancea* and *A. lanceolatus* only occurred in small amounts (0—6% and $^1/_2$—2% respectively).

The main characteristics of *A. marinus* are shown below:—

Sample	Date	Average length cm.	No.	Age-group	V.S.	No.
Horns Reef	27. 5. 54	13.18	128	I	70.15	102
Horns Reef	26. 7. 54	13.94	137	I	70.24	114
Jutland Bk.	1. 8. 55	21.36	199	I-V	69.92	100

All fishes were immature.

The mean numbers of vertebrae seem to be somewhat above the numbers hitherto recorded for *A. marinus* in the North Sea. Raitt's average V.S. figure was 69.20 in Scottish occurrences, while Kändler found a V.S. of 69.75 in a sample from Helgoland.

A more comprehensive investigation will be carried out during 1956.

K. Popp Madsen

English Market Measurements on Soles and Whiting, 1946—1955 (Tables 18 and 19)

Since 1946 regular measurements have been made of the fish landed at English ports, and recently both the number of species sampled and the amount measured have been increased in order to give up-to-date and comprehensive information on the state of all the more important commercial fish stocks. These observations have particular importance since the coming into force of the Overfishing Convention, as they provide not only an index of the composition of the stock of commercial fish, but also, in the form of actual numbers landed, express the yield to the fishermen and also the toll taken from the stock. It is hoped that the annual data from the English market measurements for all species sampled will be given regularly in the *Annales Biologiques*, but pressure of work has made this impossible for 1955. For this reason the data on the English plaice fishery have had to be omitted for this year. However, data on North Sea sole and whiting measured on Lowestoft market are available, and are given in the tables below, in which measurements for previous years are also given for comparison.

Table 18 shows the numbers (in thousands) of soles in each cm.-group landed at Lowestoft from the North Sea in each year from 1946 to 1955. Two interesting features are the rapid decline after 1946 in the war-time accumulation of large fish (see BEVERTON's paper at the 1955 meeting of I.C.E.S.), and the remarkable influx of small soles (24—28 cm., mainly the 1947 year-class) in 1949 to 1950 (see MARGETTS, Ann. Biol. VI, and BOEREMA, Ann. Biol., VII).

In Table 19 are shown the landings of whiting at Lowestoft from the North Sea in 1954 and 1955, given in terms of numbers and also %, in each

Table 18. Numbers ('000s) of Soles in each cm.-Group landed at Lowestoft by English Trawlers fishing in the North Sea, 1946—1955

Length (cm.)	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955
20	1.4	0.8	—	0.3	—	—	0.5	2.1	0.3	0.1
21	8.4	1.6	—	2.7	0.7	2.0	4.9	4.7	1.8	0.3
22	12.0	9.8	2.7	48.1	12.8	7.3	24.7	32.2	9.6	1.6
23	19.9	20.0	7.0	105.0	83.2	67.7	96.6	182.6	45.4	14.1
24	49.7	44.4	15.0	258.0	307.1	224.6	225.0	293.8	103.1	34.9
25	66.4	84.6	32.7	384.8	454.0	385.9	341.6	503.4	203.2	82.2
26	128.7	111.6	56.4	469.9	689.8	561.6	406.1	474.4	257.7	115.3
27	191.2	136.8	67.7	395.0	812.7	611.7	458.2	510.4	330.3	164.3
28	309.0	147.3	81.6	274.1	779.7	678.9	419.0	517.1	408.4	202.4
29	433.1	168.0	96.5	159.1	791.6	612.8	382.4	478.9	386.1	255.9
30	640.0	236.9	108.5	97.3	671.5	650.6	384.6	420.0	349.2	258.8
31	785.4	272.7	121.2	75.9	436.4	541.2	363.4	387.9	282.3	251.6
32	714.8	305.0	128.2	72.5	224.4	376.0	303.4	333.4	263.9	215.3
33	732.9	324.7	102.8	65.9	109.0	238.7	251.1	265.2	221.4	180.7
34	642.3	309.9	108.9	62.4	65.0	153.0	181.6	243.1	186.8	141.9
35	578.2	277.3	90.3	65.4	44.7	99.8	133.1	174.8	152.1	119.1
36	436.6	248.9	98.0	82.8	36.6	73.2	87.8	117.8	112.3	95.1
37	289.5	186.4	101.8	61.0	30.1	62.5	51.3	75.4	80.5	73.6
38	211.8	151.9	89.2	63.0	28.3	48.9	46.4	56.6	55.2	53.0
39	114.4	114.4	70.2	44.1	30.7	47.8	38.8	42.4	37.8	36.6
40	108.5	82.1	54.1	42.3	23.5	38.6	29.9	38.8	26.4	24.2
41	64.1	56.6	32.8	34.8	13.5	33.2	26.5	29.1	17.7	18.2
42	44.2	23.2	22.5	22.4	19.8	24.4	20.2	23.8	13.3	11.6
43	16.2	18.3	13.9	8.3	6.0	15.3	11.4	19.5	8.8	7.9
44	10.2	10.1	8.4	3.0	2.4	10.9	9.8	8.5	5.3	4.9
45	4.2	3.9	3.8	3.2	0.8	7.5	5.5	8.1	3.8	2.7
46	2.0	1.7	1.0	1.2	2.2	1.7	2.9	4.8	1.7	1.3
47	1.2	1.0	0.8	—	0.8	1.4	0.7	0.7	1.2	0.9
48	0.6	2.2	—	—	—	0.9	0.4	0.3	0.3	0 4
49	0.7	0.7	—	—	—	0.4	0.3	—	—	0.4
50	0.6	0.3	—	—	—	—	—	—	—	—
51+	—	—	—	—	—	—	0.2	—	0.1	—
Total	6,618.2	3,353.4	1,516.0	2,902.7	5,677.3	5,578.7	4,308.5	5,250.0	3,566.0	2,369 3
Wt. landed (cwt.)	42,718	22,559	10,566	13,855	25,005	26,403	20,426	24,496	19,039	13,985

Table 19. Landings of Whiting at Lowestoft by British Trawlers fishing in the North Sea in 1954 and 1955, giving the Numbers (in Thousands) and Percentage at each Length

Length, cm.	1954 Numbers	%	1955 Numbers	%
20	0.2	0	—	0
21	12.5	0.2	1.1	0
22	45.5	0.8	0.1	0
23	170.3	2.8	14.1	0.3
24	276.9	4.6	72.1	1.4
25	591.9	9.8	236.4	4.7
26	792.3	13.1	448.7	9.0
27	815.3	13.5	540.4	10.8
28	783.1	13.0	574.4	11.5
29	594.6	9.9	586.8	11.8
30	500.8	8.3	527.2	10.6
31	403.7	6.7	469.7	9.4
32	269.1	4.5	377.2	7.6
33	179.6	3.0	286.7	5.8
34	146.4	2.4	224.9	4.5
35	125.4	2.1	166.9	3.3
36	75.0	1.2	127.3	2.6
37	58.6	1.0	88.1	1.8
38	41.8	0.7	67.5	1.4
39	35.5	0.6	52.9	1.1
40—44	79.2	1.3	89.5	1.8
45—49	23.5	0.4	24.2	0.5
50—54	6.3	0.1	4.6	0.1
55—59	0.5	0	0.3	0
60—	—	0	0.1	0
Total	6,028.2		4,981.1	
Weight landed (cwt.)	21,429		20,923	

cm.-group up to 40 cm. and over 40 cm. in 5-cm. intervals. The decline in the smallest fish is probably due to the use of the larger mesh, and the raising of the minimum size from 20 cm.

J. A. Gulland

Rare Fishes

Scotland

The following rare fishes were landed in Scotland from the North Sea and western grounds in 1955.

Hexanchus griseus (Gmelin)—7: Off Ronas Voe, II (2); off Foula, III; N.W. Sule Skerry, IV; Rosemary Bank, VII (3).

Cetorhinus maximus (Gunner.)—3: E. Shetland, VII (2); Buchan Ness, XI.

Squatina squatina (L.)—2: Butt of Lewis, IV; Buchan Ness, X.

Torpedo nobiliana Bonaparte—4: Moray Firth, III; N. Minch, III, IX; May Island, IV.

Trygon pastinaca (L.)—3: 35'S.S.E. Aberdeen, I; Orkney, XI; Buchan Ness, XI.

Acipenser sturio L.—11: Minch, I; West Coast, I; Rattray, IV; Buchan Ness, IV; Foula, IV; Montrose, V; Butt of Lewis, V; Moray Firth, VI; Buchan Ness, VI; Skerryvore, XI; Buchan Deeps, XI.

Alosa alosa (L.)—4: Firth of Clyde, III; Moray Firth, VII; Aberdeen, VIII; West Coast, IX.

Alosa finta (Cuvier)—5: Moray Firth, II (2), III, (2); Buchan Deeps, XII.

Sardina pilchardus (Walbaum)—2: Firth of Forth, I.

Engraulis encrasicholus (L.)—1: 59°00'N.—2°00'W., XII.

Maurolicus mülleri (Gmelin)—2: St. Andrews Bay, I; Aberdeen, II.

Scomberesox saurus (Walbaum)—1: W. Shetland, VIII.

Belone belone (L.)—9: N.E. North Sea, IV, V (5); River Tweed, V; Firth of Clyde, IX (2); N. of Scotland, XII.

Malacocephalus laevis (Lowe)—1: St. Kilda, X.

Lampris guttatus (Brünnich)—2: N.W. Scotland, V; Bixter Voe, S.W. Shetland, V.

Morone labrax (L.)—3: 50'S.$^1/_2$W. Aberdeen, I; Moray Firth, I; Off Aberdeen, XI.

Naucrates ductor (L.)—1: N. Minch, IX.

Brama raii (Bloch)—12: (18 fish) Rockall Bank, VIII (4); Cape Wrath, X; Off Rattray Head, XI (2); Shetland, XI; Orkney, XI; Buchan Deeps, XI; Bell Rock, XI; Moray Firth, XI; Granton Harbour, XII (2); Portobello Beach, XII (3); 26'E.S.E. Aberdeen, XII.

Mullus surmuletus L.—6: East coast grounds, I, XI, (2), XII (3).

Spondyliosoma cantharus (Gmelin)—8: Firth of Clyde, IX, X; East coast grounds, Noss Head to Berwick Bank, XII (6).

Thunnus thynnus (L.)—1: Loch Broom, VIII.

Fierasfer dentatus Cuvier—1: N. North Sea, VIII.

Centrolophus niger (Gmelin)—1: Turbot Bank, VIII.

Mugil chelo Cuvier—6: River Dee estuary, VI, VII, VIII; Orkney, VII (2); Loch Sunart, VIII.

Trigla lineata Gmelin—2: Aberdeen Bank, II; Montrose Bank, X.

Mola mola (L.)—2: W. and N. Shetland, VIII (2).

Fuller details of these fish are available in a paper to be published in *The Scottish Naturalist.*

B. B. Rae, E. Wilson

Germany

Only three catches of "exotic" fishes are recorded in 1955. The "Institut für Meeresforschung", Bremerhaven, received, according to Dr. BRANDES, a single specimen of Ray's bream, *Brama brama* BONNATERRE 1789. It was a female, 57 cm. in length, and was caught on 11. December in 59°36'N., 1°30'E. The second catch was that of a female *Torpeda nobiliana* BONAPARTE 1835, 65 cm. in length, and caught by trawl on 17. February in 60°20–30'N., 3°17'E. The fish was received and preserved by the "Institut für Seefischerei der Bundesforschungsanstalt für Fischerei". Incidentally, this is the northernmost find of this southern species so far recorded in the eastern North Sea. A female *Alopias vulpes* GMELIN of 420 cm. length, gutted weight 170 kg., was caught by a German cutter at the end of July on the White Bank and delivered to the "Biologische Anstalt Helgoland".

G. KREFFT, A. KOTTHAUS

Sweden

The catches of rare or occasional fishes have during 1955 been rather sparse.

Kattegat-Skagerak

Trigla lyra (L.) 31.5.1955. N.W. Hanstholm, 80 fathoms.

Trachypterus arcticus (BRÜNNICH). 11.2.1955. N. of the Skaw, 80 fathoms.

Maurolicus mülleri (GMELIN). 22.3.1955. Found on the shore, Käringön, Bohuslän.

Cetorhinus maximus (GUNNERUS). 26. 11. 1955. Caught in a herring trawl, E. of Læsø, Kattegat, at 25 fathoms.

North Sea

Beryx decadactylus CUV. & VAL. 7.6.1955. E. of Viking Bank, 120 fathoms.

O. NYBELIN

Baltic-Belt Seas

INTRODUCTION

Contributions have been received from:—

Denmark:
O. Bagge
E. Bertelsen
Aa. J. C. Jensen
J. Knudsen
H. Thomsen
Germany:
G. Dietrich
R. Kändler
Poland:
I. Filarsky
Z. Mulicki
Sweden:
F. F. Koczy
G. Otterlind
U.S.S.R.:
I. Nikolaev

A. Environment

In the first half of 1955 the temperature in the Baltic was below the mean on account of the cold winter and spring, but the high air temperatures, prevailing during summer and autumn, increased the surface temperatures to above the mean in the second half of the year, with a peak in August showing temperatures of ca. 20°C. in the Belts, western Baltic, and off Gdansk. In November and December, however, the surface temperature was slightly below the mean at Swedish lightvessels in the Baltic and at Bornholm. In the Great Belt and the western Baltic the temperature in the deeper water-layers was mostly below the mean, especially in January, August, September, and December. At "Sydostbrotten" lightvessel, situated in the central Baltic, very low temperatures (below 2°C.) prevailed at 40 m. depth until ca. 1. August. Filarsky reports very low temperature (2.9°C.) measured in February in Bornholm Deep.

In September a moderate influx of saline water occurred through the Great Belt, but during the rest of the year the salinity in the deeper layers of the Belts was on the whole below the mean. At "Gedser Rev" lightvessel (but not at "Fehmarnbelt") the salinity was about normal during the last months of the year, both at bottom and surface.

In the deeper layers of the western part of the western Baltic the oxygen content was very low owing to the stagnation of the bottom layer caused by the great difference in density between the upper and lower water-layers. According to Kändler the lowest value, ca. 1 $cm.^3$, occurred about 1. August. Such low oxygen content at the bottom may in many summers cause the fish to emigrate from wide areas of more than 25 m. depth (in some years even 20 m. depth) as was the case at Als in August 1939. In 1932 the low oxygen content was found right up to the end of October, but in most years an increase occurred earlier in the year, when the autumn gales set in.

In Bornholm Deep very little or no oxygen was present below 70 m. depth. In Gdansk Deep, below 80 m., the percentage saturation of oxygen was about 40 in February, but the value decreased later on and was lowest in August.

Mulicki has investigated the occurrence and environment of the benthic animals of the southern Baltic.

In the central Baltic the quantity of zooplankton was considerably above the mean in February, but, owing to the cold winter, it was comparatively less abundant in May, as reported by Nikolaev.

The quantity of phytoplankton was extraordinarily great in the warm summer months, and the zooplankton also reached its peak in the same months.

B. The Fish

KÄNDLER has investigated the numbers of eggs and larvae at the "Fehmarnbelt" lightvessel; he found that the highest spawning intensity of the cod took place in April instead of February, which he ascribes to the low temperature of the water. At "Fehmarnbelt" the numbers of flounder eggs were fewer than usual, and those of plaice were extremely few although relatively large numbers of 0-group fish were found in summer.

Plaice. The 0-group was considerably richer than usual in spite of the adverse environmental conditions; this richness seems to be caused by the numerous stock of spawning fish.

Prospects of the plaice fishery are given according to the strength of the year-classes.

BAGGE and BERTELSEN report on the transplantations of plaice from Nissum Broad to the Belt Sea and call attention to the low percentage of recoveries. Improvement in the methods of transplantation is required to make transplantation a paying proposition.

South of Scania large plaice were plentiful owing to the small fishery intensity here. The growth-rate decreased rapidly towards the east and no plaice above 35 cm. length was taken south-east of Utklippan. At the end of the main spawning season there was a predominance of males in the III-group, an interesting feature reported by OTTERLIND.

Dab. The stock of undersized and commercial-sized dabs in the Belts has increased owing to the presence of a strong 1954 year-class. South of Scania and at Bornholm dabs were less plentiful and they belonged almost entirely to age-group III.

Flounder. The numbers of 0-group flounder were higher than usual at the Danish coasts (no report have been received from other regions). In the Belt Sea and the Sound, outside the 5 m. level the numbers of older flounder were very low.

Eel. The yield of the silver-eel fishery was predicted by Denmark.

Salmon. The German salmon fishery in the south-western Baltic increased and the yield of the 1954/55 season equalled that of the 1950/51 season. In the 1955/56 season the average landing per trip yielded 17% less than in the 1954/55 season owing to adverse weather and ice. The size of the salmon increased until February 1956. In April—May a small decrease occurred but the weight was still considerably higher than in the same months of 1955. Small salmon were very scarce. Danish investigations of catches at Bornholm show a similar increase in catches and in the size of the fish taken.

AA. J. C. JENSEN

ENVIRONMENT

Hydrography

Danish Observations (Tables 1-3)

The Belts were covered with ice at the end of February and the beginning of March. In fjords and protected fairways ice began forming in the middle of January and remained until the beginning of April.

Surface temperatures were below normal during the first half of the year and above normal in the second half; they were highest in August. Bottom temperatures were mostly below normal, particularly in January, August, September, and December.

Salinities were mostly low until August/September, when a moderate inflow of salt water took place, causing them to rise above normal. These high values persisted during the rest of the year.

H. Thomsen

Table 1. Monthly Means of Salinity and Temperature at Surface and Bottom at "Halsskov Rev" Lightvessel for a Series of Years, and the Deviations of the 1955 Values from these Means.

(From the Danish Meteorological Institute, Nautical Department)

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Salinity					**Surface**							
Mean	16.8	14.8	13.4	13.9	13.0	14.3	13.9	14.4	14.6	16.2	16.3	15.6
Deviation in 1955 ...	−0.9	−0.2[1])	—	1.7	2.6	−3.2	−2.1	−2.4	1.6	2.7	1.8	3.9
					Bottom							
Mean	21.9	21.7	24.5	27.6	29.7	30.3	29.4	27.6	24.7	23.3	21.5	22.1
Deviation in 1955 ...	−2.4	2.1[1])	—	0.0	−1.4	−3.0	−0.4	1.5[2])	4.6[3])	2.8	0.5	−0.7[4])
Temperature					**Surface**							
Mean	2.4	2.0	2.4	4.5	8.9	12.7	15.7	16.4	14.5	11.1	7.3	4.0
Deviation in 1955 ...	−0.7	−1.6[1])	—	−1.0	−0.9	−1.1	1.3	2.8	2.2	0.7	0.2	0.1
					Bottom							
Mean	3.9	3.4	3.4	4.3	5.7	7.1	9.1	11.7	13.2	11.6	8.4	5.9
Deviation in 1955 ...	−1.2	−0.3[1])	—	0.2	0.1	0.6	−0.8	−1.9[2])	−2.0[3])	−0.1	−0.2	−1.2[4])

[1]) Mean for the first 25 days of the month. [2]) Mean for 23 days. [3]) Mean for 26 days. [4]) Mean for 22 days (bottom only).

Table 2. Monthly Mean of Salinity and Temperature at Surface and Bottom at the "Gedser Rev" Lightvessel for a Series of Years, and the Deviations of 1955 Values from these Means

(From the Danish Meteorological Institute, Nautical Department)

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Salinity					**Surface**							
Mean	12.1	11.4	10.2	9.7	8.8	9.1	9.1	9.7	9.8	10.2	11.9	11.9
Deviation in 1955 ...	−0.1	−1.8	−0.9	−0.4	0.9	−0.7	−0.3	−1.6	1.1	2.6	0.7	2.0
					Bottom (17 m.)							
Mean	14.3	13.7	15.0	14.7	14.9	15.6	14.4	14.1	13.8	13.6	12.6	13.8
Deviation in 1955 ...	−0.2	−1.7	−0.1	−1.0	−2.0	−2.3	1.8	3.1	5.6	3.2	4.9	3.2
Temperature					**Surface**							
Mean	2.2	1.5	2.1	4.1	8.0	12.6	15.8	16.1	14.3	11.1	7.6	4.3
Deviation in 1955 ...	0.1	−0.7	−1.6	−0.9	−0.9	−2.3	−0.2	2.7	2.8	1.3	0.8	0.5
					Bottom (17 m.)							
Mean	3.0	2.4	2.3	3.4	5.8	9.2	12.3	13.9	13.8	11.8	8.1	5.1
Deviation in 1955 ...	−0.3	−1.4	−1.4	−1.5	−0.3	−1.4	−2.3	−2.0	−0.4	1.1	1.0	0.1

Table 3. Monthly Means of Salinity and Temperature at Christiansø for a Series of Years, and the Deviations of the 1955 Values from these Means

(From the Danish Meteorological Institute, Nautical Department)

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Salinity												
Mean	7.0	7.0	7.0	7.0	7.0	7.2	7.4	7.2	7.0	7.0	7.1	7.0
Deviation in 1955 ...	0.6	0.5	0.6	0.4	0.5	0.5	0.4	0.7	0.7	0.6	0.7	0.9
Temperature												
Mean	3.3	2.1	1.8	3.0	6.1	11.0	15.2	16.0	14.1	11.1	8.1	5.5
Deviation in 1955 ...	0.0	0.0	—0.6	—1.2	—1.0	—1.7	0.2	3.6	3.1	1.4	—0.5	—0.7

German Observations in the Western Baltic

(Tables 4-5)

Daily surface observations (8^h MET) of temperature and salinity have been made at 3 German lightships in 1955 according to the routine begun in 1949. ("Fehmarnbelt" 54°36′ N., 11°09′ E., "Kiel" 54°29.9′ N., 10°18.5′ E., "Flensburg" 54°50.3′ N., 9°53.8′ E.).

The data will be published in full in a year-book entitled "Meereskundliche Beobachtungen und Ergebnisse". Monthly means are given in Table 4.

Subsurface hydrographical observations were made once a week only at the "Fehmarnbelt" lightship. Table 4 gives the mean values of the surface observations.

The observations made at the "Fehmarnbelt" are representative of regions in which both in-going and out-going currents occur; the observations of the "Kiel" and "Flensburg" lightships illustrate the conditions in those parts of the western Baltic in which there is no strong current.

Surface temperatures in 1955 were relatively low from January to June, relatively high from July

Table 4. Monthly Means of Salinity and Temperature at Surface and Bottom, 1950/54 and 1955 for the German Lightvessels "Flensburg", "Kiel", and "Fehmarnbelt".

(From Deutsches Hydrographisches Institut, Hamburg)

Month		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Salinity					**Surface**								
"Flensburg"	Mean 1950/54	19.78	18.31	17.45	17.41	14.80	15.22	16.87	17.65	18.82	19.21	18.39	19.88
	1955	19.40	18.08	15.74	15.52	16.82	14.92	13.56	12.93	14.76	19.08	20.01	20.49
					Surface								
"Kiel"	Mean 1950/54	19.25	17.89	17.14	16.45	13.85	13.57	14.83	15.73	16.53	18.67	18.65	19.53
	1955	18.69	16.89	14.96	14.54	15.42	13.96	12.15	11.86	12.98	17.65	18.59	19.99
					Surface								
"Fehmarnbelt"	Mean 1950/54	15.44	13.50	13.52	12.98	10.33	11.73	13.17	12.11	15.36	14.78	14.53	16.38
	1955	14.24	12.67	12.27	13.52	13.49	10.61	10.03	10.02	13.41	17.12	16.17	17.30
					Bottom								
	Mean 1950/54	21.23	21.08	21.95	24.54	26.50	27.70	28.51	27.02	25.40	22.73	21.24	21.62
	1955	18.07	20.16	18.64	22.20	26.40	24.82	27.33	26.50	27.06	21.98	19.59	20.34

Month		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Temperature					**Surface**								
"Flensburg"	Mean 1950/54	2.9	1.2	1.9	4.9	10.5	14.1	15.5	16.3	14.4	11.5	7.9	5.3
	1955	2.1	0.8	—0.2	3.3	6.6	12.8	18.2	19.9	17.0	12.2	8.0	5.3
					Surface								
"Kiel"	Mean 1950/54	2.7	1.1	1.9	5.1	10.0	14.3	16.5	16.7	15.0	11.7	8.4	5.1
	1955	1.8	0.4	0.3	3.6	7.4	12.1	17.5	19.6	17.5	12.3	7.8	5.4
					Surface								
"Fehmarnbelt"	Mean 1950/54	2.9	1.3	2.0	5.3	9.4	14.2	16.4	16.7	15.1	11.7	8.4	5.3
	1955	2.3	0.4	0.6	3.7	8.1	11.2	17.0	19.5	17.3	12.5	8.1	4.8
					Bottom								
	Mean 1950/54	4.2	2.4	2.8	4.0	5.3	7.0	9.0	10.5	12.6	11.9	9.7	6.2
	1955	2.7	2.1	1.3	3.1	5.4	6.6	8.2	9.6	11.6	12.0	8.2	5.4

Table 5. Annual Mean Salinity and Temperature at Surface and Bottom

Lightvessel		1950/1954 $S^0/_{00}$	1950/1954 t°	1955 $S^0/_{00}$	1955 t°
"Flensburg"	Surface	17.81	8.87	16.78	8.83
"Kiel"	Surface	16.84	9.04	15.64	8.81
"Fehmarnbelt"	Surface	13.65	9.06	13.40	8.79
	Bottom	24.13	7.13	22.76	6.35

to October, and about normal in November and December, compared with means for the period 1950/54. Surface salinity was also relatively low in most months, and the annual means of temperature and salinity are accordingly below the 5-year means (see Table 5).

G. Dietrich

Cruises with the R/V "Südfall"

(Table 6)

Observations made on board "Südfall" during the regular cruises in Kiel Bay show the effect of the unusually warm summer of 1955. The high pressure over northern Europe, prevailing throughout the summer, caused stagnation and lack of aeration in the deeper water-layers in that part of the bay which is not reached by the strong current going through Great Belt and Fehmarn Belt. This feature resulted in a considerable reduction of the oxygen content, as shown in Table 6.

In early summer the vertical salinity gradient showed an increase, as usual. During August the stratification remained almost unchanged. Towards the end of August the increase in temperature reached its peak with 19—21°C. in the upper 15 m. layer; above the bottom lay water of less than 9°C. The consequence of this stagnation was an increasing reduction of the oxygen content of the bottom water spreading to the upper water-layers. The extreme values were as follows: less than 1 $cm.^3/l.$ O_2 (= 13% saturation) above the bottom (30. 8.), 3.1 $cm^3./l.$ (= 46%) at a depth of 15 m. (6. 9.), and 5.4 $cm^3./l.$ (= 83%) at 2 m. depth (14. 9.). The average oxygen content in the whole water column (0—28 m.) was less than 4 $cm^3./l.$ during September, with a minimum of 3.5 $cm^3./l.$ (= 52%) in the middle of this month. At this stage the bottom water was replaced by warmer water of higher salinity, but low oxygen content, too. As a result the older water masses rose and the salinity at all levels increased, while the temperature gradually decreased. Favoured by heavy western winds, this process continued until the beginning of October, when the vertical gradients of temperature and salinity almost disappeared. The mean content of oxygen was, however, less than 4 $cm^3./l.$ (= 57%) which proves that this water had remained stagnant over a longer period. Finally, at the end of October, a complete renewal took place by the influx of well aerated, but less saline, water, causing an inversion of the temperature gradient.

R. Kändler

Table 6. Hydrographic Observations off Boknis Eck, 54°33.0′ N., 10°5.2′E., June—October 1955

m.	30. June °C.	30. June $S^0/_{00}$	30. June O_2	11. August °C.	11. August $S^0/_{00}$	11. August O_2	30. August °C.	30. August $S^0/_{00}$	30. August O_2
0	15.80	13.30	—	20.19	11.43	—	21.12	11.59	6.21[1]
5	14.69	14.97	7.44	19.33	11.49	6.36	20.82	12.24	6.16
10	11.89	15.45	6.87	17.85	13.70	6.13	19.76	13.33	6.47
15	9.78	16.93	5.82	11.14	18.48	4.60	19.00	14.27	6.03
20	7.48	18.46	5.63	8.63	20.62	3.14	11.56	18.29	3.76
25	5.80	19.96	2.26	9.21	22.52	3.07	8.73	21.62	1.03
28	—	—	—	—	—		8.75	21.71	0.96

m.	14. September °C.	14. September $S^0/_{00}$	14. September O_2	7. October °C.	7. October $S^0/_{00}$	7. October O_2	25. October °C.	25. October $S^0/_{00}$	25. October O_2
0	16.12	15.08	5.38[1]	13.26	21.26	—	10.28	18.83	—
5	16.62	17.35	4.66	13.30	21.29	4.94	10.80	18.91	6.94
10	13.40	19.98	3.93	13.48	22.44	4.52	10.73	18.99	6.93
15	12.02	20.92	3.25	13.25	22.59	3.38	10.59	19.26	6.72
20	11.57	21.65	3.00	12.70	22.87	2.94	11.55	19.88	6.14
25	10.49	22.78	2.19	12.46	23.10	2.87	11.60	20.60	4.96
28	10.33	22.86	1.90	12.20	23.12	2.28	12.35	22.15	3.42

[1]) 2 m.

Table 7. Monthly Mean Salinity and Temperature in 1955 at Surface and Bottom at Swedish Lightships with the Deviations from 30-Year Means

(Deviation figures are shown in italics)

Salinity	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
					Surface							
"Sydostbrotten"	5.59	—	—	—	—	4.56	3.45	4.64	4.46	5.23	5.42	—
	+0.2	—	—	—	—	*−0.1*	*−0.9*	*+0.4*	*−0.1*	*+0.3*	*+0.2*	—
"Grundkallen"	5.63	5.80	—	—	5.74	5.71	5.70	5.67	5.62	5.71	5.72	5.64
	+0.2	*+0.3*	—	—	*+0.2*	*+0.4*	*+0.5*	*+0.6*	*+0.4*	*+0.4*	*+0.3*	*+0.3*
"Svenska Björn"	6.39	6.40	—	6.35	6.10	6.04	5.94	5.75	5.96	6.21	6.50	6.88
	+0.2	*+0.2*	—	*+0.3*	*+0.2*	*+0.3*	*+0.4*	*+0.3*	*+0.3*	*+0.3*	*+0.4*	*+0.7*
"Falsterborev"	8.63	8.30	7.74	7.79	8.18	7.95	8.01	7.92	8.01	9.21	8.57	9.33
	+0.4	*+0.2*	*0*	*+0.3*	*+0.7*	*+0.4*	*+0.1*	*0*	*+0.1*	*+0.8*	*+0.3*	*+1.1*
"Oskarsgrundet"	10.00	10.00	—	9.89	10.21	8.40	8.65	8.19	9.17	12.01	10.75	10.64
	−1.1	*−1.3*	—	*+0.4*	*+1.8*	*+1.4*	*−1.3*	*−1.4*	*−1.6*	*−0.2*	*+0.2*	*−1.3*
Depth m.					Bottom							
"Sydostbrotten" .. 40	5.77	—	—	—	—	5.98	5.98	6.12	6.04	5.94	5.78	—
"Grundkallen" 40	5.79	5.92	—	—	5.86	5.88	5.92	5.92	6.18	5.81	5.79	5.98
"Svenska Björn" .. 40	6.57	6.92	—	6.97	7.22	6.80	6.78	7.68	7.20	7.94	7.17	7.09
"Falsterborev" 10	8.94	8.51	7.87	7.81	8.18	7.99	8.08	7.92	8.21	9.29	8.58	9.57
"Oskarsgrundet" . 8	12.36	9.45	—	12.40	12.32	8.44	10.41	8.63	15.13	12.54	11.97	11.10
Temperature					Surface							
"Sydostbrotten"	—	—	—	—	—	8.1	14.5	16.1	12.8	7.4	4.3	—
	—	—	—	—	—	*−0.3*	*+0.4*	*+0.7*	*+0.9*	*+2.6*	*+1.1*	—
"Grundkallen"	1.5	—	—	—	1.8	6.2	14.7	16.4	15.1	10.0	5.7	2.5
	0	—	—	—	*−1.4*	*−1.8*	*+0.4*	*+0.5*	*+2.3*	*+1.3*	*−0.1*	*−0.9*
"Svenska Björn"	2.2	1.0	—	—	3.1	7.2	15.0	17.4	15.8	9.8	5.9	3.4
	−0.2	*−0.2*	—	—	*−1.1*	*−1.7*	*+0.3*	*+1.6*	*+2.7*	*+0.8*	*−0.7*	*−0.9*
"Falsterborev"	2.3	1.0	0.3	2.8	6.3	11.1	16.1	19.8	17.5	12.8	8.1	5.2
	−0.6	*−0.8*	*−1.7*	*−0.9*	*−1.5*	*−1.3*	*+0.3*	*+3.3*	*+2.8*	*+1.1*	*−0.3*	*+0.1*
"Oskarsgrundet"	2.2	0.8	—	2.8	7.1	11.3	16.5	19.2	17.2	12.4	7.9	4.4
	−0.6	*−1.1*	—	*−1.5*	*−1.3*	*−1.8*	*+0.4*	*+2.5*	*+2.4*	*+1.0*	*+0.1*	*−0.3*
Depth m.					Bottom							
"Sydostbrotten" .. 40	—	—	—	—	—	1.5	1.8	2.3	2.9	4.2	4.6	—
"Grundkallen" 40	1.8	—	—	—	1.1	2.9	3.6	4.3	4.5	5.7	5.6	2.8
"Svenska Björn" .. 40	3.3	2.5	—	—	2.0	3.8	3.5	4.6	5.1	5.9	5.3	3.7
"Falsterborev" 10	2.3	1.0	0.3	2.7	6.2	10.2	15.0	19.2	17.6	12.6	8.1	4.9
"Oskarsgrundet" . 8	2.4	1.1	—	2.9	7.0	11.1	16.1	18.9	16.0	12.5	8.1	4.7

Table 8.

West of Gothland 56°58′ N., 20°37′ E. 26. March				Gothland Deep 57°20′ N., 20°07′ E. 25. March				Landsort Deep 58°35′ N., 18°15′ E. 25. March			
Depth m.	Temp. ° C.	Sal. ‰	Oxygen ml.	Depth m.	Temp. ° C.	Sal. ‰	Oxygen ml.	Depth m.	Temp. ° C.	Sal. ‰	Oxygen ml.
0	1.27	7.31	—	0	1.32	7.86	—	0	−0.01	6.74	9.73
60	1.78	7.70	7.69	70	1.93	7.87	9.20	20	−0.03	6.79	—
70	4.41	9.31	3.34	90	4.33	9.17	—	30	1.19	7.21	9.06
99	4.81	10.62	0.86	140	5.39	12.09	2.32	60	4.59	9.61	—
				190	5.72	13.16	1.85	70	4.86	10.51	1.34
								147	5.18	11.25	1.12
								447	5.20	11.67	1.50

Swedish Observations

(Tables 7–8)

The surface temperature observations at Swedish lightships (Table 7) clearly reflect the effect of the extremely long and warm summer, in which the temperatures in August and September were more than 3°C. above the mean. The winter temperatures were all below the mean. Bottom temperatures were mostly below the mean, except at the lightships in shallow water ("Oskarsgrundet" and "Falsterborev").

As far as may be judged from the fact that no high salinity values were recorded in the Sound during the year, no inflow appears to have occurred. To the contrary, salinity seems to have been lower than usual. The low values caused by the melt water occurred at "Oskarsgrundet" in June about a month later than usual.

Observations were made in the deep basins in March. The data will be published in full in the *Bulletin Hydrographique*. The salinity transition layer in the eastern part of the Baltic was found to lie at about 90 m., that is, deeper than in the preceding year, but in the western part it was at a higher level, about 60 m. The oxygen content in Gothland Deep was somewhat higher than in 1954, perhaps as a result of the influx which occurred in the autumn of 1954.

F. F. Koczy

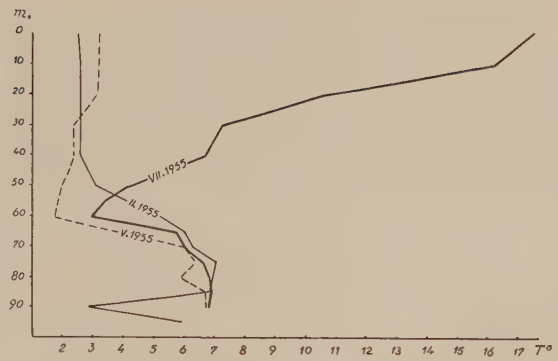


Figure 2. Station B_1. Temperature at various depths in different months.

Polish Investigations in the Southern Baltic

(Figures 1–7)

The collection of hydrographic data at the routine stations Gdansk Deep, Slupsk Furrow, Bornholm Deep, and Arkona Deep was continued.

In February a wedge of cold water, with a temperature of 2.9°C., appeared at a depth of 90 m. in Bornholm Deep. At the same time a similar wedge was observed in the central part of the Slupsk Furrow, where the temperature at 80 m. was 1.6°C.

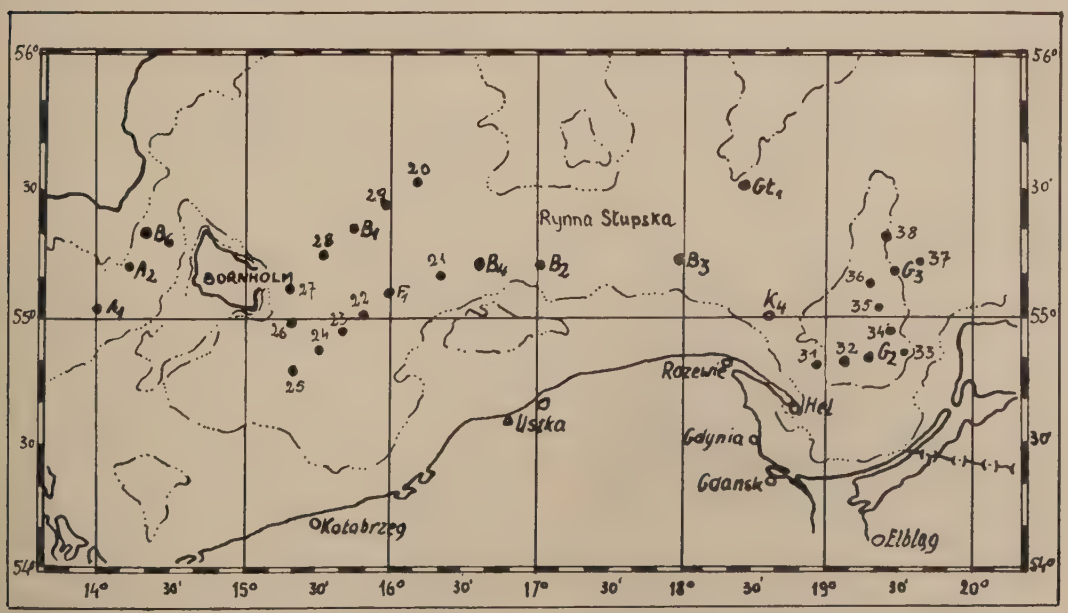


Figure 1. Positions of the hydrographic stations occupied in the southern Baltic in 1955.

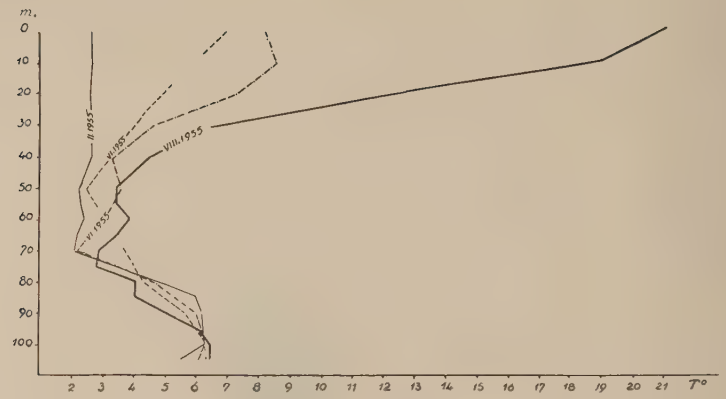


Figure 3. Station G_2. Temperature at various depths in different months.

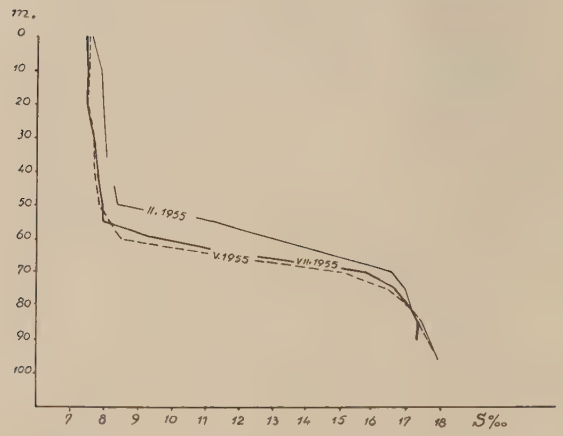


Figure 4. Station B_1. Salinity at various depths in different months.

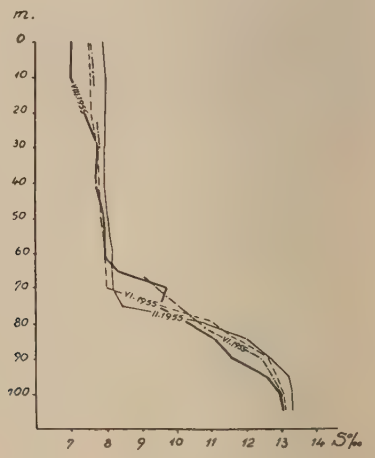


Figure 5. Station G_2. Salinity at various depths in different months.

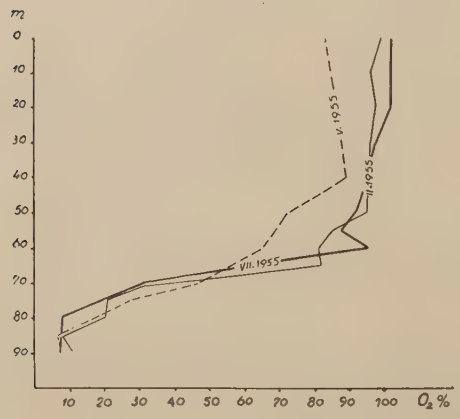


Figure 6. Station B_1. Percentage saturation of oxygen.

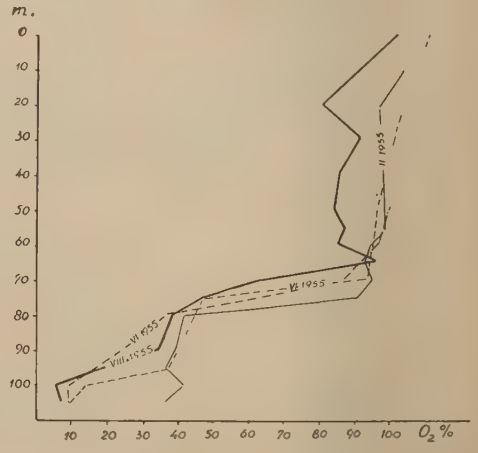


Figure 7. Station G_2. Percentage saturation of oxygen.

In July and August the temperature of the superficial layers oscillated about 17.5°C., but was as high as 20.9°C. in Gdansk Deep.

The salinity of the water at 90 m. in Bornholm Deep at that time oscillated between 17.30 and 17.86‰, while that of the bottom layers in Gdansk Deep was 13.28‰.

The oxygen content of the near-bottom waters of Bornholm Deep was rather low, minimal values being recorded at 80—90 m. in May and July.

In February the oxygen saturation of the water between 80 and 105 m. in Gdansk Deep oscillated between 36 and 42%, but later decreased rapidly, the lowest value occurring in August.

The accompanying graphs (Figs. 1—7) illustrate changes of temperature, salinity, and percentage saturation of oxygen in Bornholm and Gdansk Deeps.

J. Filarski

Plankton

Observations at Bornholm

Aphanizomenon "flowered" extraordinarily strongly in the warm summer. In August, when the quantitative catches were made, most of the sea surface appeared yellow and in one place near the coast the quantity was so great that the bottom could not even be faintly seen at 20 cm. depth; in several other places it could just be seen at 50 cm. depth.

The fat content of the dried plankton obtained in 9 vertical hauls on 25.—27. August with the Hensen net averaged 16.3%, varying between 13 and 25. This is about the same as the mean annual values since 1944.

Aage J. C. Jensen

Russian Observations in the Central Baltic, between Klaipeda and the Estonian Islands

(Table 9)

The winter (February) plankton was considerably more abundant than in all previous years, both in numbers and weight.

The spring (May) plankton was noticeably poorer, as a result of the lateness of the season. In 1955 the plankton in May corresponded to plankton in April of previous years as regards both quantity and species present.

The summer (July—September) plankton was more abundant than usual, particularly in July.

I. Nikolaev

Table 9. Average Quantity and Weight of Zooplankton in 1955

	February	April	May	July	August	September
			0 to 20 metres			
Number of adults per m^3	2,966	295	3,307	14,984	11,512	9,926
Nauplii, Copepodae	778	1,398	6,800	1,508	448	104
Biomass, mg./m^3	143.08	—	64.44	363.82	220.44	175.40
			25 to 50 metres			
Number of adults per m^3	1,246	336	2,330	4,766	2 561	5,549
Nauplii, Copepodae	248	439	3,656	158	37	24
Biomass, mg./m^3	58.73	—	37.29	133.51	71 18	114.29
			50 to 100 metres			
Number of adults per m^3	1,101	581	2,755	3,529	3,631	3,819
Nauplii, Copepodae	48	60	2,937	41	0	1
Biomass, mg./$m.^3$	51.56	—	76.72	144.38	122.09	91.50
			100 metres to bottom			
Number of adults per m^3	130	—	525	345	—	—
Nauplii, Copepodae	0	—	45	1	—	—
Biomass, mg./m^3	2.57	—	43.64	11.53	—	—

Benthonic Food

Ecology of the more Important Invertebrates of the Baltic

(Figures 8–14; Table 10)

In order to establish the ecological needs of some of the bottom-living invertebrates in the Baltic Sea, studies were made of the changes in biomass occurring with changes in certain enviromental conditions, namely, depth of water, type of bottom, and temperature, salinity, and oxygen content of the bottom water.

The following species were studied:—

Lamellibranchia

Macoma baltica (Linné)
M. calcarea (Chemnitz)
Astarte borealis (Chemnitz)
Mytilus edulis Linné

Crustacea

Pontoporeia femorata Kröyer
P. affinis Lindström
Mesidotea entomon (Linné)
Diastylis rathkei (Kröyer) f. *typica* Zimmer

Polychaeta

Terebellides strömi M. Sars
Scoloplos armiger (O. F. Müller)

Priapulides

Halicryptus spinulosus Siebold
Priapulus caudatus Lamarck

The investigations were arranged so as to provide quantitative data from which the biomass of the particular species in different places could be determined. At the same time the environmental conditions had to be defined and correlated with the biomass.

The data were obtained during the period 1950—52 from 110 stations in the southern Baltic, between Rugia in the south and west and the parallel of 56°45′ in the north.

The bottom samples were taken with a sampler of the Petersen type, temperatures were observed by means of a bathometer, and water samples were collected for hydrological analyses.

The association between the biomass of a species and the enviromental factors is drawn by means of isobents. In these graphs the value of one of the ecological factors is represented on the abcissa and the depth of the bottom on the ordinate. The diagrams obtained indicate the depth, temperature, salinity, oxygen content associated with the occur-

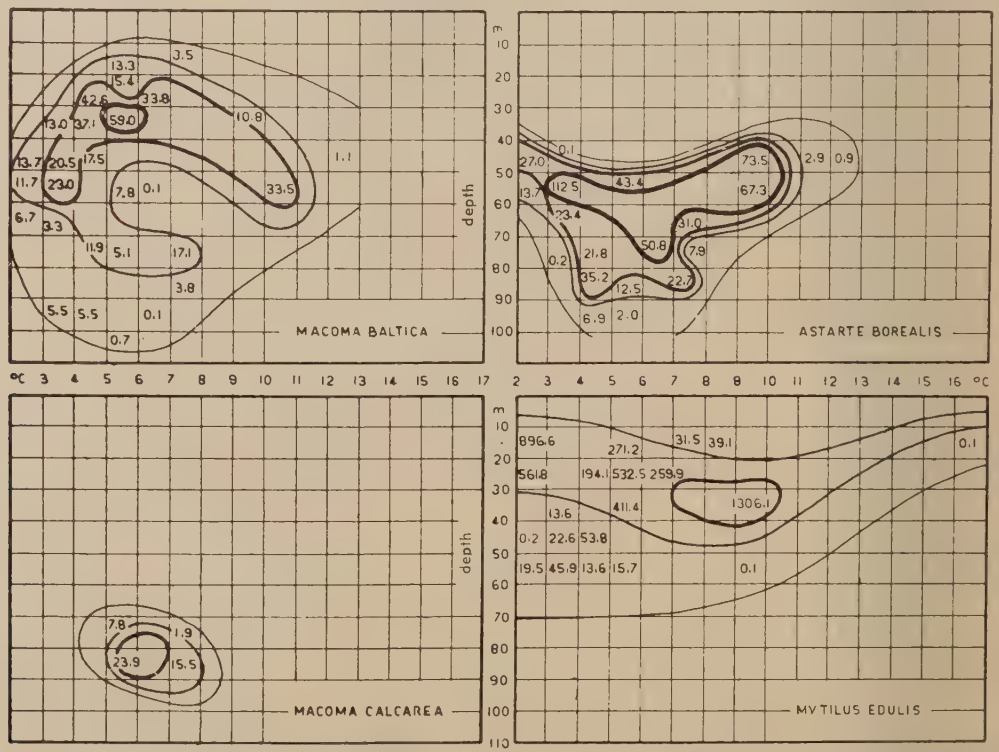


Figure 8. Thermic requirements of some mussels from the southern Baltic. Figures encircled by isolines indicate the mean biomass of the species in g./m.² of bottom.

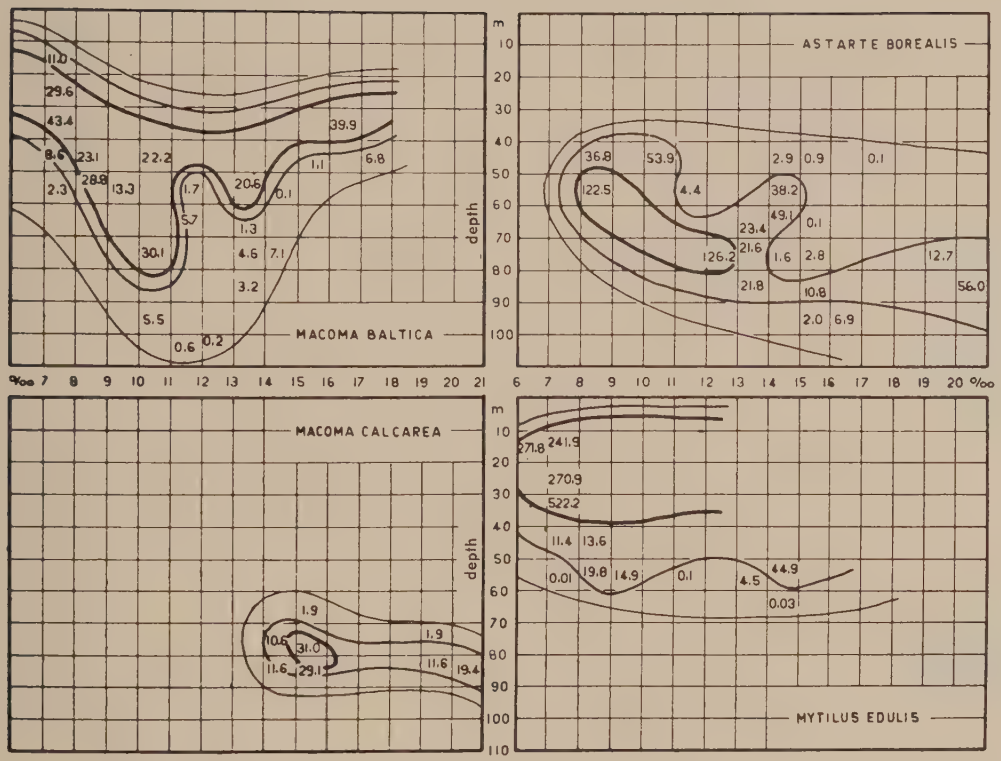


Figure 9. Biomass of some mussels from the southern Baltic (in g./m.² of bottom). Distribution according to salinity and depth.

rence of the species (Figs. 8—10). These diagrams are supplemented by diagrams illustrating the character of the bottom, Figure 11, so that the relation of the particular species to the five environmental features mentioned above can be established (Figs. 12—13, pp. 116 and 117).

Our observations permit the south Baltic species to be characterized as follows:—

Macoma baltica is particularly responsive to changes in oxygen content and soil; it is not much affected by temperature, salinity and depth, and in the southern Baltic these factors have very little influence on the biomass.

Macoma calcarea needs a low and stable temperature, a relatively high salinity and a muddy bottom. This species is markedly tolerant of waters of low oxygen content.

Astarte borealis requests a water of high oxygen content, a temperature not exceeding 10°C., a salinity not lower than 8‰, and a bottom of clay, sandy mud, or fine sand.

Mytilus edulis is a eurybiotic species, but it demands water rich in oxygen and a hard bottom to which it can attach itself.

Pontoporeia femorata is satisfied with a low salinity and oxygen content. It can adopt itself to a fairly wide range of temperature, but prefers rather cool water. This species is evidently most particular about the bottom, from which it derives its nourishment.

Pontoporeia affinis requires above all water of high oxygen content, not less than 4 ml./l. Salinity should be about 10‰, temperature between 2 and 6°C., and the bottom should be of sand or sandy-muddy.

Mesidotea entomon occurs most frequently in the southern Baltic in waters of salinity not exceeding 15‰, and a temperature below 12°C. Other factors are of minor effect.

Diastylis rathkei f. typica is not much affected by the oxygen content of the water, but needs a salinity of at least 7.59‰ and a low temperature

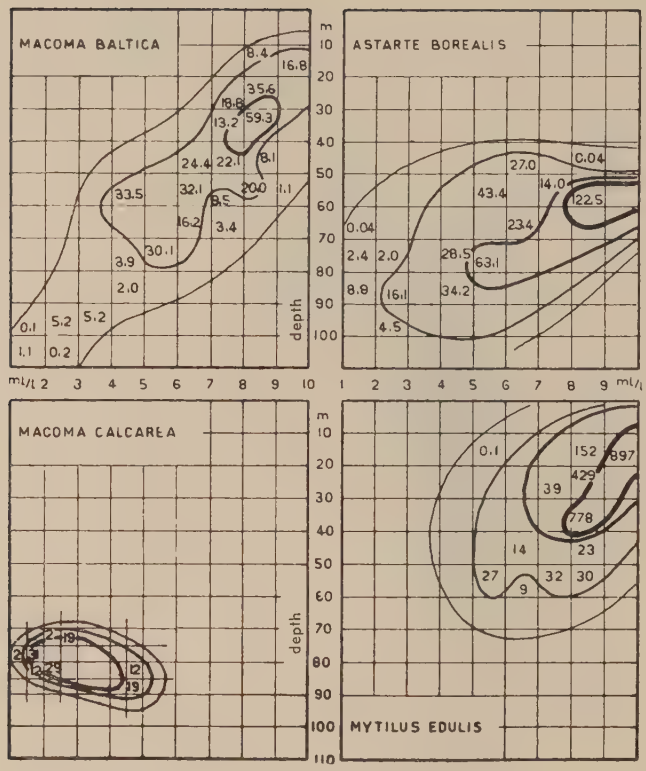


Figure 10. Biomass of some mussels from the southern Baltic (in g./m.² of the bottom). Distribution according to oxygen content.

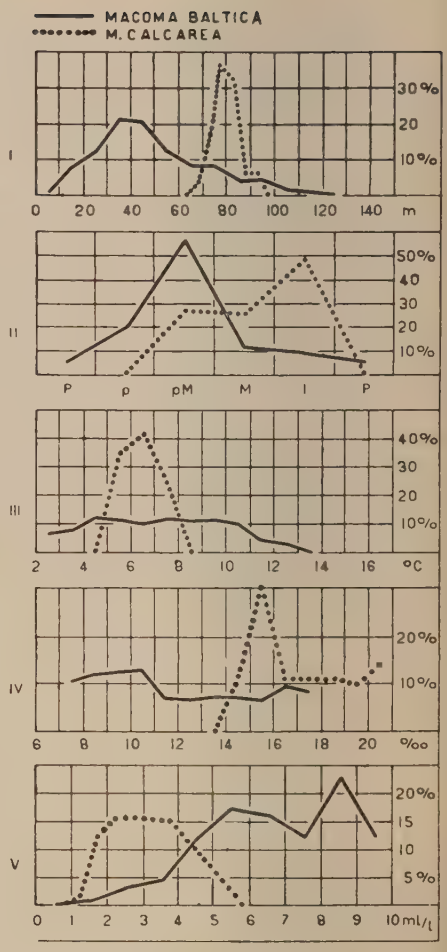


Figure 12. Environmental conditions of the *Macoma* species of the southern Baltic. I = Depth; II = type of bottom (P = coarse sand, p = fine sand, M = soft mud, pM = sandy mud, I = clay); III = temperature; IV = salinity; V = oxygen content.

Figure 12

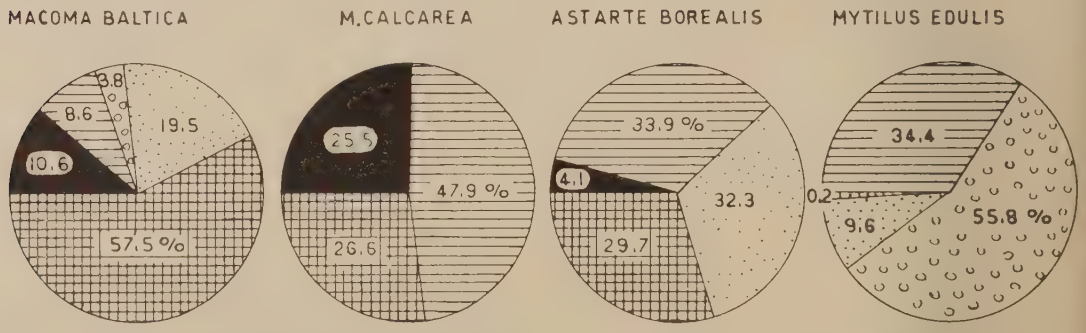


Figure 11. Percentage biomass of mussels from the southern Baltic distributed according to type of bottom.

Clay
Coarse sand
Fine sand
Sandy mud
Soft mud

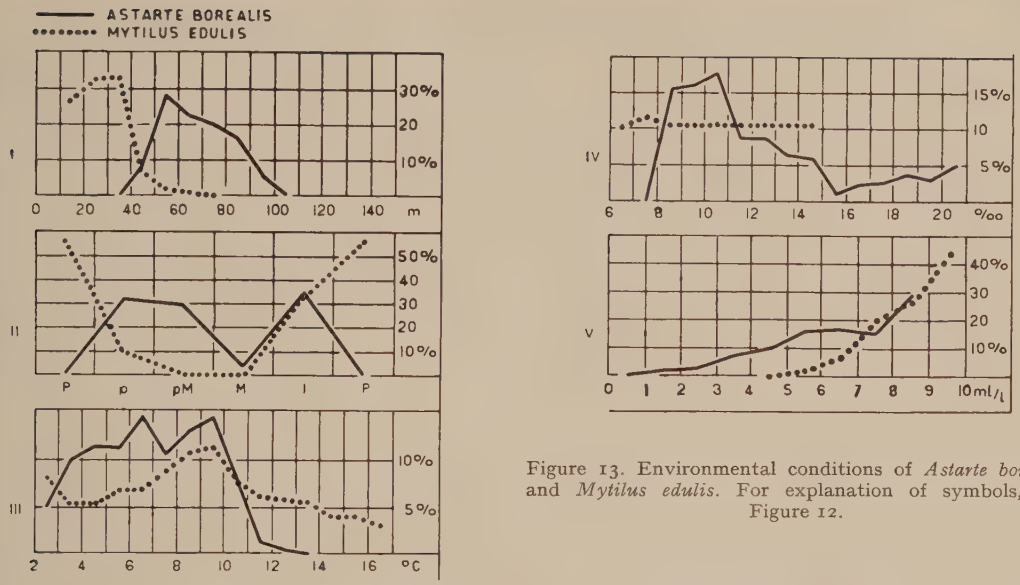


Figure 13. Environmental conditions of *Astarte borealis* and *Mytilus edulis*. For explanation of symbols, see Figure 12.

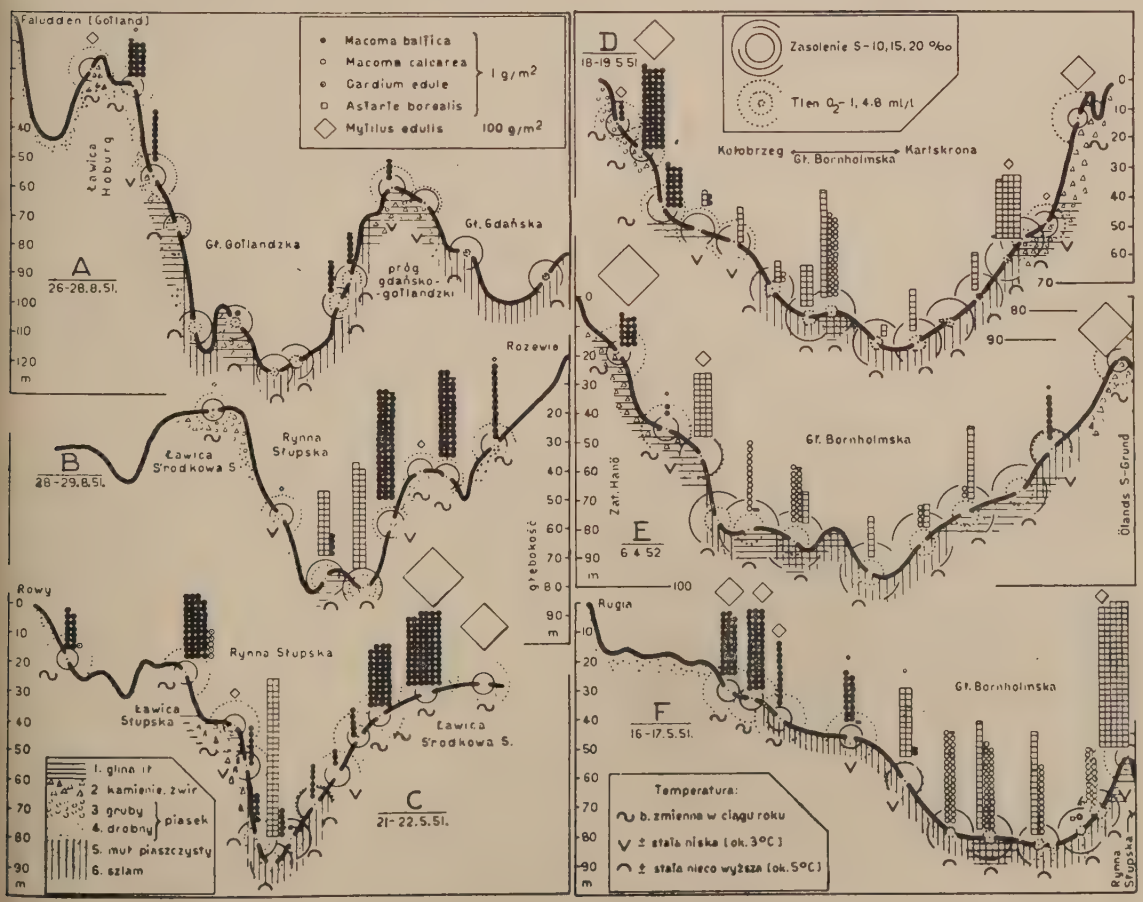


Figure 14. Cross-sections of the southern Baltic showing the quantitative distribution of some mussel species in relation to environmental conditions.

Table 10. Zoobenthos and Environmental Conditions in the Southern Baltic

Species	Depth m.	Type of Bottom	Temp. °C.	S $^0/_{00}$	O_2 ml./l.
Macoma baltica	*6—115*[1]	pM, p, *M*, *I*, *P*[2]	*2.1—13.0*	*7.20—18.37*	*1.03—9.20*
	30—50		5—6	?	>4
M. calcarea	*63—92*	I, M, pM	*5.4—7.7*	*13.95—20.48*	*1.37—5.00*
	75—85		**5—7**	>15	>1.5
Astarte borealis	*40—92*	I, p, pM, *M*	*2.2—13.0*	*7.77—20.48*	*1.09—8.85*
	40—90		3—10	>9	>5
Mytilus edulis	*15—70*	K, I, P, *M*	*2.0—16.4*	*6.91—14.67*	*5.39—9.20*
	10—40		8—10	?	>7
Pontoporeia femorata	*35—123*	pM, M, *I*, *p*	*2.1—13.0*	*7.67—19.52*	*1.47—9.05*
	90—110		3—7	10—11	2—3
P. affinis	*6—77*	p, pM, M, P, I	*2.0—11.9*	*7.20—18.37*	*4.45—9.05*
	30—60		2—6	<10	>7
Mesidotea entomon	*25—123*	pM, p, *M*, *P*, *I*	*2.0—11.3*	*7.14—14.38*	*1.47—9.05*
	50—110		2	9—14	>1.5
Diastylis rathkei	*21—108*	I, pM, p, *M*, *P*	*2.2—11.9*	*7.59—20.48*	*1.07—8.85*
	70—108		2—6	9—16	>1.7
Terebellides strömi	*25—108*	I, pM, p, M	*2.1—12.2*	*7.26—19.31*	*1.95—9.05*
	40—80		8—11	13—15	4—6
Scoloplos armiger	*40—161*	p, pM, M, *I*, *P*	*2.0—12.2*	*7.72—19.31*	*1.03—9.05*
	50—90		?	>7.72	3—5
Halicryptus spinulosus	*25—123*	I, pM, M, p	*2.2—11.3*	*7.20—19.52*	*1.03—8.85*
	40—90		4—11	13—15	>3
Priapulus caudatus	*18—123*	M, I, pM, *p*, *P*	*1.5—7.7*	*6.91—20.48*	*1.95—8.95*
	?		<7.7	>6.91	>2

[1]) Figures in italic indicate limiting values; figures in roman type optimal values; and figures in heavy type, values of particular significance. [2]) P = corse sand, p = fine sand, M = mud, pM = sandy mud, I = soft mud, K = stones, gravel. The letters in italics indicate bottoms in which the species is very seldom present.

of 2—6°C., and not higher than 12°C. The bottom must be rather soft, so that the animal may dig itself in quickly.

Terebellides strömi is distinguished by its high degree of eurythermism, with an inclination to fairly high temperatures (max. 12.2°C.). It needs moderately salt or brackish water, of salinity not below 7.26 $^0/_{00}$ and an oxygen content of at least 1.95 ml./l. (optimally 4—6 ml./l.). The bottom soil must be fine.

Scoloplos armiger is distinctly eurybiotic; it hardly responds to changes in depth, kind of ground, temperature, oxygen or hydrogen sulphide content. The only factor restricting the distribution of this species is the reduction of salinity northwards, as the bottom grows gradually shallower.

Halicryptus spinulosus requires primarily a temperature not exceeding 11°C. and a soft bottom. The optimal salinity for the species, in this region, is 13—15 $^0/_{00}$. The oxygen content should be 3 ml./l. or more, lower values leading to a decline in the biomass.

Priapulus caudatus exhibits considerable tolerance as regards nature of the bottom. Temperature should not exceed 8°C., the oxygen content should not fall below 2 ml./l., and salinity should not be less than 6.91 $^0/_{00}$.

The optimal and upper limiting values of the various factors are given in Table 10.

A number of biological sections (Fig. 14, p. 117) illustrating the relation of the species studied to the environment in the southern Baltic are presented.

Z. Mulicki

THE FISH

Eggs and Larvae

In the 1955 breeding season, the average numbers of eggs per m.² near the lightship "Fehmarnbelt" were as follows:—

		Dec.	Jan.	Febr.	March	Apr.	May	June	July	Aug.
Cod	1955	2	0.5	8	15	37	2	0.5	—	—
	1934—43	4	15	81	49	24	3	1	—	—
Plaice	1955	—	0.5	—	1.5	0.5	-	—	—	—
	1934—43	0.5	0.5	2	1	1	—	-	—	-
Flounder and Dab	1955	—	—	—	0.5	52	4	12	16	2
	1934—43	—	—	8	23	35	35	18	3	—
Sprat	1955	—	—	—	—	—	3	4	11	2
	1934—43	—	—	—	—	—	22	60	60	5
Mackerel	1955	—	—	—	—	—	—	0.5	15	—
	1934—43	—	—	—	—	—	—	1.5	0.2	—

As in the two previous years, the spawning of the cod was interrupted because of low water temperature, and reached its maximum only in April, instead of February, as usual. The number of cod eggs has greatly diminished, to one-third of the year before, and of the average of 1934—43. A similar decrease is observed in the flounder, and to an alarming extent, in the sprat. On the other hand, the number of mackerel eggs shows a further rise, and now surpasses that of the sprat. The eggs of the plaice show by far the lowest frequency. There is no sign of recovery of the stock of this species.

R. KÄNDLER

Flatfish

Danish Investigations

(Tables 11–12)

1. Studies of the O- and I-groups in coastal waters

In 1955 considerably more 0-group **plaice** than normal were taken in the quantitative hauls with the Johansen young-plaice trawl (see Table 11). This year-class was over 7 times more abundant than usual in the western Baltic and was nearly as plentiful there as in the Belts and the Sound; the mean for many years in the western Baltic is about half that in other areas. Even on the east coasts of Seeland and Falster it was about as plentiful as it normally is in the Belts and Sound, whereas normally it is only a little more than one-tenth as plentiful here as it is in the other localities. At Bornholm it seems to have been somewhat less abundant than usual, as the catches of the Johansen young-plaice trawl here normally are twice the size of those with the hand push-net.

That this year provided a rich year-class is very remarkable; it is unexpected, because the experience of many years is that low water temperatures, such as occurred in the early months of 1955 are followed by a poor year-class. No doubt this rich year-class is attributable to a particularly heavy stock of spawning fish.

Table 11. Preliminary Figures for the Numbers of 0-group Plaice, Flounder, and Turbot caught per Hour with the Johansen Young-Plaice Trawl, and with the Hand Push-net (H.P.) at Bornholm

(Figures in brackets are means for a series of years)

	Number of stations	Plaice	Flounder	Turbot
Belts, Aug.–Sept.	61	133 (28)	5 (0.4)	3 (2)
— Oct.	29	62	1	0
W. Baltic, Aug.	7	105 (14)	3 (2)	3 (1)
— —, Oct.	3	15	0	0
Sound, Sept.	7	101 (28)	56 (5)	1 (2)
E. coasts of Seeland and Falster, Sept.	10	25 (3)	77	1 (4)
Bornholm, Aug.	9	39	502	5
— (H.P.)	17	>9 (17)	673 (231)	27 (25)

The numbers of I-group plaice were small; this conforms with the finding of a poor 1954 year-class during the coastal investigations last year.

In October some of the stations were repeated, and the average density was found to be about half that in July—September; this corresponds with the variation found in some previous years. July, August, and September seem to be about equally good for making quantitative catches of 0-group plaice, but it might be stressed that fishing should be undertaken when the sea is flat calm. With any swell or waves higher than about 5 cm., the catches of 0-group plaice are very much diminished.

Flounder of the 0-group were taken in the Belts and Sound in very much larger quantities than normal. As has been mentioned before, in the Kattegat and the Belts 0-group flounder are found mostly in bays and fjords with bottoms of mud or mud and sand but this year comparatively large quantities were caught off the open coasts, especially in the southern part of the Great Belt, to the south of Fyn, and in the Sound. These fish are abundant on the Baltic coasts and in 1955 the catches at Bornholm were very much above normal.

0-group **turbot** were a little more plentiful than normal in the Belts and western Baltic, less so in the Sound, and about normal at Bornholm.

The catches of 0-group **sole** were considerably above normal in the Belts where they averaged 0.5 soles per hour. On the Kattegat coasts the catches of 0-group soles were very much higher; in July—August they were 8—9 soles per hour in the northern and southern parts of the Kattegat and 2 in the central part.

2. The stock of plaice in the open sea

In the Belts in water of more than 5 m. depth the stock of plaice was higher than in 1954, because immigration from shallower water had occurred. The shallowest depth-zone used in Table 12 is 5—14 m. but actually little or no quantitative fishing was carried out in depths less than 9 m. Accordingly a considerable proportion of the plaice under about 15 cm. in length must have been outside the area fished. It may be seen that there were more plaice present over the Danish size-limit, viz. 26 cm., than formerly and in fact the fishery was more prolific than it had been for many years past. Stocks have not been so high since just after the war. The present high yields are due mainly to the rich year-classes of 1952 and 1953, the latter having appeared in the stock of marketable plaice in the autumn. In 1956 available stock for the fishery will still be plentiful but in the course of the year most of it will be fished out, and the present period of high yields will come to an end. In the western Baltic the stock is somewhat less dense, but the waters less than 15 m. deep were not covered by the Danish investigations. Moreover the stock in relatively shallow waters in the Sound has not been examined but it will be seen from Table 12 that for waters deeper than 15 m. there were more large plaice in the western Baltic and the Sound than in the Belts. This is normal for the Sound and is due to the prohibition of trawling and seining in these waters. For the western Baltic, however, it seems to be that the larger stock is due to the intensity of fishing in the shallower waters being lower here than in the Belts, and therefore more fish of the 1952 year-class have spread to water over 15 m.

In the neighbourhood of Møen and at Bornholm plaice appeared to be a little less plentiful than in the western Baltic and the Sound. At Møen, however, we fished no water less than 15 m. deep and none shallower than 35 m. at Bornholm. In the latter region neither plaice nor other fish were taken at more than 70 m. depth, where the water contained very little oxygen. At both Møen and Bornholm almost all the plaice were of the III-group (1952 year-class).

Aage J. C. Jensen

Table 12. Catch per Hour in Quantitative Hauls with the Standard Trawl

	Depth zone m.	Number of stations	Centimetre groups 6–10	11–15	16–20	21–25	26–30	31–35	36–40	41–45	46–50	Total
Belts												
July–September ...	5–14	11	3	3	57	71	7	—	—	—	—	141
	15–35	17	0.4	0.2	1	10	13	2	0.4	0.1	—	27
October–December .	5–14	17	2	4	9	60	22	1	—	—	—	98
	15–35	21	0.1	1	1	4	8	2	0.3	0.1	—	17
Western Baltic												
May–December	15–35	13	—	—	—	1	1	3	2	2	0.2	9
Sound												
April–December ...	5–14	1	—	—	—	—	2	—	4	—	2	8
	15–35	6	—	—	0.3	0.3	1	3	5	1	0.3	11
Møen												
April–December ...	15–35	7	—	—	—	0.3	3	3	1	—	—	7
Bornholm												
August	35–70	10	—	—	—	0.2	3	2	0.2	—	—	5

3. Transplantation of plaice

Plaice were transplanted from Nissum Broad to the Belt Sea between 12. April and 26. May. The work was somewhat delayed by the coldness of spring and by the late arrival of the fish in the Broad. In all 1,052,000 fish (80,000 kg.) were liberated in various parts of the Belt Sea. Eleven hundred of these fish were marked with Petersen disks. By the end of the year 9% had been recaptured (9% in 1954 also) and most of these were from three lots liberated in Smålandshavet (south of Seeland). In addition, 900 plaice were marked with roll-tags. This method of marking does not have the disadvantage of the Petersen disk, namely, that fish tagged with Petersen disks are more easily entangled in the net than untagged fish (cf. Ann. Biol., XI, p. 66). Over the years as a whole the best results were obtained from liberations in Smålandshavet, where 15% of the Petersen disks and 9% of the roll-tags were recovered by the end of the year. The estimated value of the yield from this liberation in 1955 was only about one-third of the expenditure. As the results of the transplantations to other parts of the Belt Sea were even less satisfactory, and as very few recaptures may be expected in 1956, the tagging experiments confirm the view that, in most years at least, transplantation of plaice to the Belt Sea will not pay unless the methods can be radically improved.

To decide the question whether the relatively long transport in well-smacks could account for the very high mortality of the plaice handled, 400 marked plaice were carried by air from Nissum Broad to Bagenkop (southern Langeland) and Smålandshavet, and liberated there. During the journey, which lasted about $1^1/_2$ hours, the fish were kept in boxes lined with wet straw. At the same time, two well-smacks left Nissum Broad with loads of plaice. On their arrival at Bagenkop and Smålandshavet, plaice of the same size as those transported by air were selected and the same numbers marked and liberated.

By the end of the year the recaptures were as follows:—

	Petersen disks %	Roll-tags %
Transported by air	18.5	10
Transported in well-smacks...	8.5	6

Although air transport seems to have led to an improvement in the percentage recaptures, the number is still so low, compared with the results obtained in the Limfjord, for instance, that it seems unlikely that the means of transport are entirely responsible for the unsatisfactory results of the Belt Sea transplantation.

O. Bagge, E. Bertelsen

Dab

The following table gives the numbers of dabs caught by "Biologen" per hour's haul with the cod trawl. The number of hauls is given in brackets.

	1955	1954
N. Belts	787 (26)	279
S. Belts	586 (48)	43
W. Baltic	82 (13)	50
Sound	71 (5)	119
Møen	12 (8)	22
Bornholm	1.7 (14)	0

It appears that in most areas the stock of dabs has increased considerably as compared with 1954. This is due mainly to the presence of very large numbers of I-group dabs in some localities (for instance, to the north of Fyn and in the Århus Bay). On the other hand, in the Sound and off Møen, the stock appears to be somewhat smaller than in the previous year; in these places, the I-group dabs were less numerous than elsewhere.

J. Knudsen

Flounder (Table 13)

On the average, the numbers of flounder caught were a little higher than in 1954, but the figures are very low and no special significance can be

Table 13. Numbers of Flounder caught per Hour's Trawling with the "Biologen" in 1955

	Depth m.	No. of stations	Length, cm. 16–20	21–25	26–30	31–35	36–40	41–45	Total
Samsø Belt–Great Belt	5–14	18	0.8	2.0	2.8	0.1	—	—	5.7
	15–35	23	0.1	1.1	1.1	0.4	—	—	2.7
Smålandshavet	13–17	10	0.2	3.2	3.6	0.8	0.2	—	8.0
Little Belt	15–35	33	0.3	1.8	3.2	1.3	0.5	0.1	7.2
Western Baltic	15–34	13	—	0.2	0.2	0.6	—	—	1.0
Sound, Møen	14–34	15	—	0.1	0.3	0.1	0.4	0.7	1.6
Bornholm	35–70	10	—	—	—	—	—	—	0.0

put upon them. Very few 0-group flounder have been taken in hauls with the Johansen young-plaice trawl in coastal waters during the previous years; most of the flounder caught were of the II- and III-group.

AAGE J. C. JENSEN

Swedish Investigations of Flatfish

(Tables 14 and 15)

In 1955 trawling experiments were made with the research vessel "Skagerak" in the southern Baltic during the period 21. February—26. April. The investigations, which covered 41 trawling hours, were carried out in five main areas: A) ca. 25 miles S.S.E. of Trelleborg, depth 43—50 m., 3 trawling hours; B) ca. 12 miles W.N.W. of Rønne, depth 41—44 m., 4 trawling hours; C) ca. 12 miles E.S.E. of Simrishamn, depth 69—80 m., 4 trawling hours; D) ca. 11 miles S.E. of Dueodde, Bornholm, depth 65—73 m., 10$^3/_4$ trawling hours; E) ca. 16 miles S.E. of Utklippan, depth 65—66 m., 7$^3/_4$ trawling hours. A few hauls were made S. and S.E. of Smygehuk (8—12 miles S. of the south coast of Scania) and S. of the coast of Blekinge (5—10 miles from the coast); the catches of flatfish in these last areas (depths 38—44 m.) were very small.

Ordinary trawls with cod-ends of mesh-size 15, 65, 70—75, and 75—80 mm. were used. The selection exercised by the different cod-ends upon the catches of flatfish was negligible, or non-existent. The differences between the local stocks of these fish could be appreciated, however. As this report is preliminary, no regard is had to mesh-size. Table 14 gives an idea of the density and length distribution of the stocks in the main localities. The numbers of fish measured are as follows: plaice 1,511, flounder 1,075, and dab 428. Table 15 presents the preliminary results of an age analysis.

Table 15. Age Distribution (%)

Species	Number examined	Age-groups II	III	IV	V	VI	VII-XI
Plaice	647	0.6	83.9	6.6	3.6	3.1	2.2
Flounder	341	0.9	65.4	29.6	3.5	0.6	—
Dab	222	0.9	92.8	5.8	0.5	—	—

Plaice. The predominance of the strong 1952 year-class is very pronounced; it comprises 83.9% of the fish examined (647). On account of the difficulty in reading their otoliths, the figures for the older fish are a little too low, however, (cf. the remarks on flounder and dab). Very few fish of age-group II were caught. This is true for flounder and dab also. Perhaps the fish now two years old will appear in the catches later on during their third year of life. The comparatively high proportion of large plaice in area A may be partly the result of a lower fishing intensity than in, for instance, area D, south-east of Bornholm. There

Table 14. Plaice, Flounder, and Dab

Area, date, and species	Total number	Number per hour	Length distribution (percentage in each cm.-group) 11–15	16–20	21–25	26–30	31–35	36–40	41–45	46–50	51–55
A. 28.–29. III.											
Plaice	272	90.7	0.4	2.9	21.3	40.8	14.3	7.0	7.0	5.5	0.7
Flounder	19	6.3	—	(10.5)	(36.8)	(5.3)	(10.5)	(31.6)	—	(5.3)	—
Dab	8	2.7	—	(37.5)	(50.0)	(12.5)	—	—	—	—	—
B. 22. II.											
Plaice	197	49.3	—	1.0	25.4	49.2	17.8	3.0	2.5	1.0	—
Flounder	189	47.3	—	2.6	37.0	50.8	9.0	0.5	—	—	—
Dab	259	64.8	—	18.9	66.0	13.5	1.5	—	—	—	—
C. 23.–24. II.											
Plaice	400	100.0	—	—	16.3	60.2	15.5	5.5	1.8	0.7	—
Flounder	103	25.8	—	1.0	19.4	43.7	25.2	8.7	—	1.9	—
Dab	41	10.3	—	12.2	61.0	24.4	2.4	—	—	—	—
C. 4.–5. IV.											
Plaice	100	28.6	—	—	21.0	59.0	15.0	2.0	3.0	—	—
Flounder	74	21.1	—	5.4	33.8	29.7	17.6	13.5	—	—	—
Dab	46	13.1	—	2.2	67.4	26.1	4.3	—	—	—	—
D. 14.–16. IV.											
Plaice	507	47.2	—	3.1	30.0	48.5	17.2	1.0	0.2	—	—
Flounder	539	50.1	0.2	14.1	58.6	20.2	5.4	1.1	0.4	—	—
Dab	63	5.9	—	6.3	50.8	39.7	3.2	—	—	—	—
E. 20.–26. IV.											
Plaice	35	4.5	—	2.8	25.7	62.9	8.6	—	—	—	—
Flounder	151	19.5	—	22.5	54.3	21.9	1.3	—	—	—	—
Dab	11	1.4	—	(45.4)	(9.1)	(36.4)	(9.1)	—	—	—	—

are, however, indications that the growth-rate is slower in area D than in area A. The absence of plaice larger than 35 cm. in area E is no doubt attributable mainly to the fact that the fish there are living close to the limits of their distribution.

As regards sex ratio it may be mentioned that 72.0% of the 543 fish of age-group III examined were males. Females predominated in this group (sample dated 22. 2.) in area B only; the percentage of males was 30.5%. The corresponding values for areas A, C, D, and E respectively were 73.4, 96.3, 75.0 and 93.3% (all samples dated later than 22. 2.). In age-group IV the males comprised 48.8% (43 fish examined); females predominated in the higher age-groups, and in the VII-group and upwards there were no males at all (14 females in groups VII—XI).

Flounder. In this species, age-groups III and IV were the most important, comprising 65.4 and 29.6%, respectively, of the 341 fish examined. The II-, V-, and VI-groups together made up 5%. The highest density of fish observed was in area D. Small fish were most numerous in areas D and E. Males formed 79.4% of the III-group and 43.6% of the IV-group. All the main areas yielded more males than females of the III-group.

Dab. Catches of this fish were very small and indicate a poor stock. Area B exhibited the highest density. Age-group III predominated with 92.8%, followed by the IV-group with 5.8% (the II- and V-groups together made up 1.4%). In all 222 fish were examined. Males formed 65.5% of the III-group and were predominant in all the main areas.

Gunnar Otterlind

Eel

Prediction of the yield of the silver-eel fishery

Summer temperatures led to a predicted yield for the silver-eel fishery in the Belt Sea of about 25% above normal. According to the fishery statistics, the catch was 13% above normal in the Belts, 36% above normal in the western Baltic, 46% above normal in the Sound, and 27% above normal on the Baltic coasts of Seeland, Møen, and Falster.

The **tumour disease** was on the whole somewhat less frequent than in 1954.

Aage J. C. Jensen

Salmon

The yield of the German salmon fishery in the south-eastern part of the Baltic shows a further increase, e.g., from 116 tons in 1954 to 157 tons in 1955, due to good catches in the spring. The season of 1954/55 (October—May) was a very good one, the yield of 195 tons was equal to that of the 1950/51 season (196 tons), whereas the intervening years were poor showing catches of only 75 tons. For the 1955/56 season a new decrease is expected caused by the severe frost in the beginning of 1956. The average landing per trip which in 1954/55 rose to 594 kg. dropped to 493 kg. in 1955/56, when a number of trips were hindered by adverse weather and ice in February 1956. In March, however, this deficit was to a certain extent balanced by record catches taken after the sea was once more free of ice.

The size composition of the landings at Kiel fish market was as follows:–

Market category	V	IV	III	II	I
Gutted weight, kg.	<2	2—3	3—4.5	4.5—8	>8
			Number (%)		
1955 Jan.-Febr.-March	6	23	19	43	9
April-May	12	26	16	35	11
Nov.-Dec.	4	15	13	56	12
1956 Jan.-Febr.	2	13	16	47	22
March-April	2	21	26	35	16

There is a remarkable change in the size composition. The percentage of fish belonging to market category I increased steadily until February 1956 after which date there is a decline. Category II maintains a dominant position throughout, while category IV, which held the next best position in the 1954/55 season, shows a steady decline until February, when category I takes the second place. Very remarkable also is the insignificant part played by the smallest category V in the 1955/56 season.

R. Kändler

Comité Atlantique

SOMMAIRE

I. Hydrologie

G. R. Berrit, Travaux d'hydrologie à Pointe-Noire.

II. Plancton

S. le Roux, Recherches sur le phytoplancton.
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L. Marteil, Observations sur la reproduction d'*Ostrea edulis* L. en Morbihan pendant l'année 1955.
L. Marteil, Acclimatation de *Gryphea angulata* Lmk. sur les côtes sud de Bretagne.

J. Furnestin

LES CONDITIONS DE MILIEU

Hydrologie

Hydrologie à Pointe-Noire

La Section d'Océanographie Physique a entrepris de réunir, au moyen des observations faites par des bateaux marchands, des renseignements concernant les eaux superficielles du plateau continental africain de Pointe-Noire à Cotonou. Plus de 1000 observations de température et environ 300 échantillons d'eau ont été recueillis de la sorte en 1955, permettant de donner d'ores et déjà les grandes lignes des variations saisonnières.

Dans tout le domaine étudié on a pu distinguer un certain nombre de régions qui se différencient par la position et la durée de la saison fraiche, et surtout par l'amplitude des variations thermiques et salines.

La nappe d'eaux dessalées du contre-courant équatorial s'étend vers le sud, toute l'année jusqu'à Port Gentil, en saison chaude au sud de Pointe-Noire où elle rejoint les eaux du Congo.

Cette lentille d'eaux saumâtres — dont la salinité descend jusqu'à $20^0/_{00}$ — a une épaisseur d'une vingtaine de mètres. Elle est soumise à des pulsations annuelles en relation avec les précipitations et le régime des vents.

Les observations qui se poursuivent actuellement visent à préciser les variations annuelles des salinités. La région de Pointe-Noire a été particulièrement étudiée et la station dispose maintenant de 4 années d'observations continues de températures et de salinités.

Des points d'observations établis dans la région sud à Mayumba à Port Gentil permettent de suivre l'évolution des masses d'eau côtières, et confirment jusqu'à présent le schéma établi sur la base des observations effectuées plus au large.

G. R. Berrit

Plancton

Recherches sur le Phytoplancton

L'étude du phytoplancton du Bassin d'Arcachon, entreprise en 1954, s'est poursuivie en précisant les variations quantitatives subies par les diatomées et les péridiniens.

Si les diatomées d'origine benthique présentent des maxima fonction des coefficients de marée, les espèces pélagiques semblent d'avantage liées aux conditions hydrologiques, notamment à la température: au cours de l'année, elles montrent, dans la majorité des cas, plusieurs périodes d'abondance, dont les plus importantes coïncident avec les températures comprises entre 12 et 16°C. au printemps et en automne.

La formation de spores a été observée en particulier dans les genres *Chaetoceros* et *Ditylium*.

D'autre part, les genres *Biddulphia*, *Rhizosolenia* et *Ditylium* ont fourni au début du printemps et en automne de nombreuses formes tératologiques.

Les examens de plancton de diverses provenances ont montré, au début de l'automne, l'apparition en abondance de péridiniens. Dans les eaux de l'étang de Thau (côte méditerranéenne), à l'absence quasi-totale de diatomées, s'opposait une grande richesse en péridiniens dont les espèces: *Ceratium fusum* (Ehrenberg), *Ceratium bricatum* (Ehrenberg Cleve), *Goniaulax polyedra* Stein, *Peridinium conicum* (Gran), *P. saltans* (Meunier), *Prorocentrum micans* (Ehrenberg).

S. le Roux

Phytoplancton dans la Région de Pointe-Noire

La densité du phytoplancton dans les eaux côtières de la région de Pointe-Noire est observée régulièrement au moyen de dosages colorimétriques des pigments chlorophylliens.

Les eaux sont les plus riches aux mois de Juin, Juillet, Août, Septembre, où la température de surface est inférieure à 22°C.

La densité du phytoplancton est en moyenne deux fois plus faible à 8 milles au large que dans les eaux très proches de la côte.

De Novembre 1954 à Novembre 1955, la moyenne annuelle a été de 12.2 mg. de chlorophylle/m.^{3} près de la côte, et de 5.8 mg./m.^{3} seulement à 8 milles au large. A la côte, le maximum a été observé pendant le mois de Septembre, avec une moyenne de 17.5 mg./m.^{3}; le minimum se situe en Février avec 1.8 mg./m.^{3}.

G. R. Berrit

LES POISSONS

Observations sur la Sardine dans le Sud du Golfe de Gascogne

D'après les observations biométriques exécutées depuis 1954 par le laboratoire de l'Institut des Pêches Maritimes, à Biarritz, on constate dans les sardines provenant de la région sud du Golfe de Gascogne, deux anomalies qui distinguent l'année précédentes:—

1) En Janvier 1955, apparition d'un stock de petites sardines, groupe 0, taille modale 120 mm., à moyenne vertébrale élevée, de 52.35, alors qu'on ne rencontrait cette moyenne que sur la sardine du groupe I, de 140 à 150 mm., qui se trouve normalement en Avril-Mai dans la région landaise.

2) En Avril 1955, ont apparu dans la même région des sardines dites "coureuses", des groupes V à VII, taille modale 230 mm., stade sexuel V, VI, et VII. Ces grosses sardines sont exceptionelles dans le sud du Golfe; leur moyenne vertébrale de 52.11 les rapproche de la petite sardine pêchée habituellement dans la région: 52.05 à 52.10.

G. de la Tourrasse

Note Préliminaire sur la Croissance de *Gadus luscus* Cuv. Val. au Maroc

Les observations portent sur des individus capturés au large de Casablanca. Les chalutiers qui ramènent les poissons de cette espèce, draguent les fonds de 80 à 110 m.

Les longueurs totales (L.T.), prises du bout du museau à l'extrémité du lobe caudal supérieur, sont ramenées au centimètre, et groupées par mois pour l'année 1950 et Janvier 1951.

Le côté des mailles utilisées par les chalutiers locaux étant, à cette date, inférieur à 25 millimètres, on peut estimer que le pouvoir sélectif des engins ne joue que pour les tailles inférieures à 10 cm.

Tableau 1. Fréquence de *Gadus luscus* Cuv. et Val. pendant toute l'Année 1950 et Janvier 1951

	Janvier		Février		Mars		Avril		Mai		Juin	
Cm.	Fréq.	%	Fréq.	%	Fréq.	%	Fréq.	%	Fréq.	%	Fréq.	%
10	—	—	—	—	—	—	11	0.1	—	—	—	—
11	21	1.5	—	—	—	—	0	0.0	-	—	—	-
12	126	9.4	19	3.3	8	2.1	8	0.6	—	—	—	-
13	314	23.5	133	23.1	56	15.0	106	8.6	20	2.2	—	—
14	**354**	**26.5**	**191**	**33.2**	**97**	**25.9**	298	24.3	92	10.0	12	1.9
15	247	18.5	119	20.6	86	23	**332**	**27.1**	**181**	**19.6**	45	7.1
16	131	9.8	63	11.0	52	13.9	221	18.6	179	19.3	108	16.9
17	62	4.6	22	3.8	32	8.5	128	10.4	**181**	**19.6**	**150**	**23.5**
18	30	2.3	13	2.2	17	4.5	64	5.2	117	12.6	138	21.7
19	22	1.6	3	0.5	8	2.1	30	2.4	70	7.6	69	10.8
20	11	0.8	1	0.2	9	2.4	19	1.5	48	5.2	59	9.2
21	8	0.6	2	0.3	3	0.8	10	0.8	10	1.1	30	4.7
22	4	0.3	3	0.5	3	0.8	3	0.2	12	1.3	11	1.7
23	4	0.3	4	0.7	2	0.5	2	0.1	8	0.9	7	1.1
24	3	0.2	1	0.2	2	0.5	0	0.0	4	0.4	3	0.5
25	4	0.1	2	0.3	—	—	1	0.1	1	0.1	3	0.5
26	—	—	—	—	—	—	—	—	1	0.1	1	0.2
27	—	—	—	—	—	—	—	—	—	—	0	0.0
28	—	—	—	—	—	—	—	—	—	—	1	0.2
Totaux	1341	100.0	576	99.9	375	100.0	1233	100.0	924	100.0	637	100.0

	Juillet		Août		Septembre		Octobre		Novembre		Décembre		Janvier 1951	
Cm.	Fréq.	%	Fréq.	%	Fréq.	%	Fréq.	%	Fréq.	%	Fréq.	%	Fréq.	%
10	—	—	—	—	—	—	—	—	—	—	1	0.1	—	—
11	—	—	4	0.5	3	2.0	—	—	8	0.4	11	0.8	—	—
12	—	—	7	0.8	9	6.1	8	1.0	66	3.5	73	5.3	17	0.9
13	2	0.3	14	1.6	**23**	**15.6**	57	7.5	286	15.1	218	15.9	168	8.5
14	7	1.2	23	2.6	12	8.2	125	16.1	**576**	**30.5**	**355**	**25.8**	505	25.6
15	55	9.3	73	8.4	8	5.4	**130**	**16.8**	489	25.7	354	25.7	**511**	**26.0**
16	130	22.0	159	18.3	8	5.4	83	10.7	211	11.1	225	16.3	326	16.6
17	**143**	**24.3**	**193**	**22.2**	14	9.6	103	13.3	107	5.6	64	4.7	158	8.1
18	112	19.0	153	18.0	15	10.2	102	13.1	54	2.8	44	3.2	92	4.7
19	54	9.2	93	10.7	17	11.6	65	8.4	38	2.1	14	1.0	66	3.4
20	42	7.1	79	9.1	22	14.9	46	5.9	32	1.7	9	0.7	43	2.2
21	19	3.2	37	4.2	12	8.2	29	3.7	20	1.1	6	0.4	33	1.7
22	13	2.2	19	2.2	3	2.1	20	2.6	4	0.2	1	0.1	20	1.0
23	9	1.5	8	0.9	1	0.7	5	0.6	3	0.2	—	—	12	0.6
24	1	0.2	4	0.5	—	—	1	0.1	—	—	—	—	8	0.4
25	2	0.3	—	—	—	—	1	0.1	—	—	—	—	2	0.1
26	1	0.2	—	—	—	—	1	0.1	—	—	—	—	3	0.2
27	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Totaux	590	100.0	866	100.0	147	100.0	776	100.0	1894	100.0	1375	100.0	1964	100.0

Modes observés

Les tailles s'échelonnent de 10 à 26 cm.

Le Tableau 1 montre que durant 10 mois de l'année un seul mode apparaît.

En Septembre la courbe est bimodale, car les jeunes atteignent une taille suffisante pour être capturés par le chalut.

Le mois de Novembre est marqué par la disparition des individus de grande taille et le retour à un polygone de fréquences unimodal.

Croissance

Ce nouveau mode qui apparaît en Septembre est, on peut le supposer, dû à la venue de jeunes nés l'été précédent.

La croissance au cours de la première année est importante, et voisine de 13 cm. Pendant la deuxième année, elle n'est pas régulière :

— de Novembre à Janvier elle est lente et dépasse à peine 1 cm.

— à partir de Mars elle s'accélère jusqu'en Juin et atteint 3 cm.

— de Juin à Août on note un nouveau ralentissement correspondant vraisemblablement à la période de reproduction.

Conclusion

a) La croissance de *Gadus luscus* au Maroc est importante pendant la première année et atteint 12 à 13 cm.

b) Elle se réduit considérablement l'année suivante, dépassant à peine 4 cm.

c) Après s'être reproduits, au cours de leur deuxième année d'existence, la quasi totalité des adultes disparaît.

R. Coupé et Cl. Maurin

Conditions de Milieu et Reproduction d'*Ostrea edulis* L. en Morbihan pendant l'Année 1955

Les premières larves d'huîtres apparurent au début du mois de Juin 1955 dans les rivières d'Auray et de Crach, avec un retard de dix jours environ sur les années normales. Le maximum de la première émission ne fut atteint que les 19 et 22 Juin alors qu'il survient vers le 15 Juin, le plus souvent. Les froides températures du printemps ont été vraisemblablement la cause de ces retards, comme elles le furent en 1951 et en 1954.

Le pourcentage maximum de ponte fut d'abord observé chez les huîtres de la rivière de Crach; il ne le fut que dix jours après sur les bancs aval de la rivière d'Auray et vingt jours après sur ceux d'amont. Les numérations de larves, bonnes en rivière de Crach, furent d'autant plus faibles en rivière d'Auray que, le processus de formation des produits génitaux ayant commencé tardivement dans la partie haute, la quantité d'embryons libérée par chaque huître fut nettement inférieure à la normale, qu'il n'y eut pas simultanéité dans la ponte pour toute la rivière et que la plupart des émissions survient en période de vives-eaux, ce qui favorisa la dispersion par les courants.

Il n'y eut pas, comme à l'accoutumée 2 ou 3 grandes émissions de larves, mais une succession de petites libérations se prolongeant jusqu'à la fin du mois d'Août. Les larves évoluèrent rapidement, une forte proportion atteignant le stade de fixation. Les collecteurs immergés en rivière de Crach captèrent chacun plusieurs centaines de larves mais ceux qui furent déposés en rivière d'Auray ne furent que médiocrement garnis de naissains.

Les phénomènes constatés chez les huîtres des gisements amont de la rivière d'Auray semblent imputables aux conditions très défavorables auxquelles elles furent soumises du mois de Décembre 1954 à celui de Mars 1955: des pluies diluviennes, qui en plusieurs provinces provoquèrent des crues désastreuses, y abaissèrent considérablement la salinité des eaux par le fait des apports de ses affluents, le Loch et le Sal, dont le cours draine un arrière-pays étendu.

Acclimatation de *Gryphea angulata* Lmk. sur le Côtes Sud de Bretagne

La culture de l'huître portugaise a été autorisée, à titre d'essai, en 1948, dans les rivières d'Etel et de Pénerf, à l'est et à l'ouest du bassin morbihannais, centre producteur d'huîtres plates, *Ostrea edulis* L.

La production annuelle de gryphées atteint environ 6000 tonnes. L'économie de l'industrie ostréicole, dans ces rivières, en a été heureusement modifiée sans qu'il y ait de conséquences néfastes pour l'élevage de l'huître indigène. Le gisement naturel d'huîtres plates établi dans la rivière de Pénerf est demeuré très prospère; son rendement par embarcation et par jour de pêche est passé de 115 kg. d'huîtres pour la période 1944—1947 à 145 kg. pour la période 1950—1954.

L'apport d'huîtres portugaises à la périphérie du bassin morbihannais n'a eu jusqu'ici aucune répercussion sur la production d'huîtres plates dans le Golfe, les rivières d'Auray, de Crach ou de Plouharnel exclusivement consacrés à cette culture. Les collecteurs qui y sont déposés n'ont pas été envahis par le naissain de gryphée et les jeunes portugaises qu'on y trouve occasionnellement fixées ne sont pas plus nombreuses depuis 1948 qu'elles ne l'étaient avant. La direction des courants dominants semble d'ailleurs s'opposer à un entraînement des larves de l'Etel et de la Pénerf vers les centres du Morbihan.

L'acclimatation de la gryphée aux nouvelles conditions de milieu s'est manifestée par une croissance satisfaisante et une augmentation de poids. Mais bien qu'on puisse observer partout la formation de produits génitaux se développant jusqu'à maturité, il n'y a pas toujours libération des gamètes.

Température et salinité semblent être les facteurs déterminants de l'extension naturelle de *Gryphea angulata* Lmk. sur les côtes de Bretagne, extension qui paraît conditionnée par la conjonction $S \geqslant 34‰$ et $T \geqslant 20°C$. Dès 1949, l'huître portugaise s'est établie à l'intérieur et sur les rives de la Vilaine où cette condition est normalement réalisée. L'importance et la constance des fixations en cette région ont permis d'y envisager l'implantation d'une industrie de captage dont nos essais ont précisé les modalités.

L. Marteil

Gadoid Fish

YOUNG STAGES

Greenland

Cod Fry and Small Cod in Coastal Waters and on the Offshore Banks of West Greenland, 1955

(Figures 1-2; Table 1)

Occurrence of cod fry

The numbers of larval cod (*Gadus callarias* L.) caught by "Dana" in July with the 2 m. stramin net are given in Figure 1. In general the numbers were small, the largest catch being 10 in a haul with 100—25 m. of wire out. There were most larvae on the southern part of Store Hellefiske Bank, and there were none in the stramin-net hauls on the two southern sections in Davis Strait (only one larva was taken on the Frederikshåb section); this probably indicates that no cod fry were brought over by the current from the Icelandic or other spawning grounds.

The scarcity of cod fry suggests that the 1955 year-class will be very poor and will contribute little to the yield of the fishery in the future.

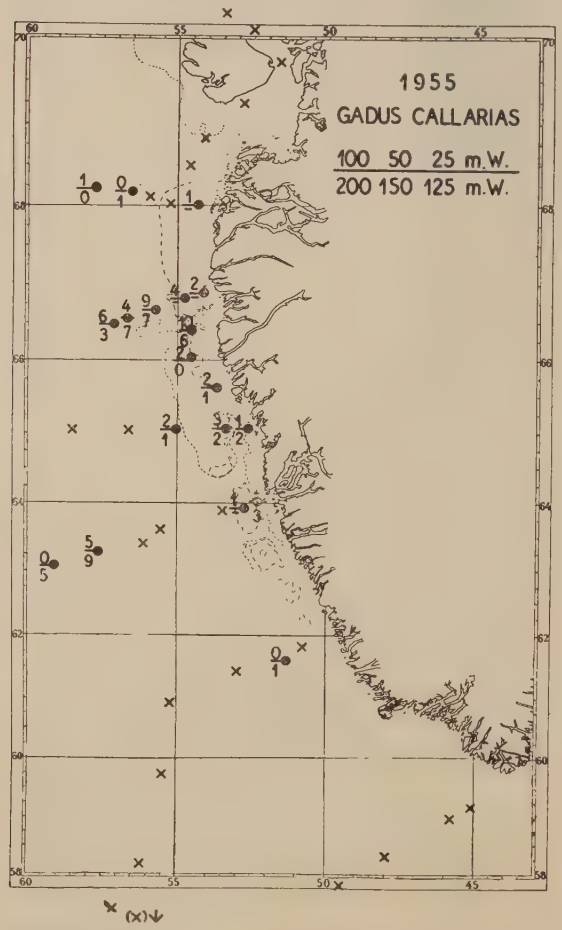

Figure 1. Catches of cod larvae with a 2 m. stramin net per 30 minutes haul by the "Dana", July—August 1955. Numbers in hauls with a 100—25 and a 200—125 m. of wire out are shown above and below the line, respectively.

Occurrence of small cod of age-groups I, II, and III

Small cod were taken in fairly large numbers in hauls with the fine-mesh seine in several inshore

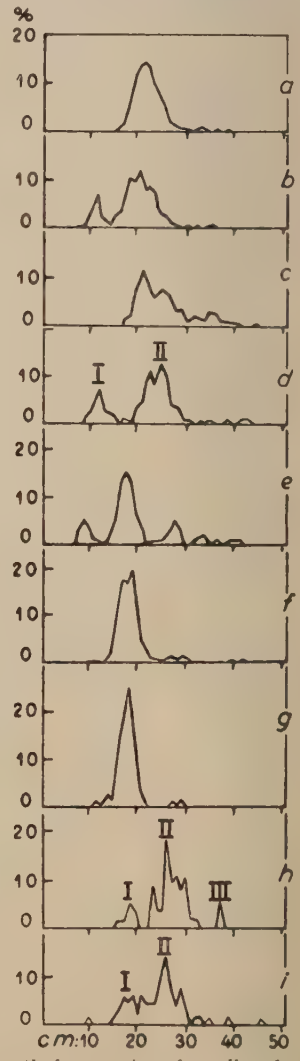

Figure 2. Length frequencies of small cod, age-groups I, II, and III.

Table 1

Sample	Position	Date 1955	Gear	Number of fish
a	66°55′N., 53°40′W.	22/6	seine	1159
b	65°43′N., 53°12′W.	30/6	,,	786
c	64°19′N., 50°25′W.	14/6	pound-net	420
d	60°36′N., 45°14′W.	23/8	seine	181 (ages determined)
e	63°53′N., 51°28′W.	20/1	shrimp-trawl	157
f	,, ,,	19/2	,, ,,	698
g	,, ,,	4/4	,, ,,	92
h	,, ,,	26/11	,, ,,	53 (ages determined)
i	,, ,,	20/12	,, ,,	63 ,, ,,

localities and in the fjords, especially in the Godthåb, Sukkertoppen, and Holsteinsborg districts. In addition, small cod were taken in a shrimp trawl at a point off the coast (63°53′N., 51°28′W.) in depths between 220 and 240 m.; in this locality trawling experiments have been regularly carried out since July 1953 at all seasons of the year.

The 1953 year-class predominated in all the 1955 catches, and there is therefore reason to consider it a good year-class, which will contribute to the fishery in 1958—59 and onwards.

The length frequencies of small cod taken with the hand-seine, pound-net, and shrimp-trawl at the different stations in West Greenland waters are given in Figure 2; other details of the catches are given in Table 1. It is apparent that one size-group alone, that between 15 and 25 or 30 cm., dominates the catches. Otolith readings have shown that this size-group corresponds to the II-group (i.e., the 1953 year-class).

P. M. Hansen

Table 2. Larval Cod, Haddock, Whiting, and Saithe June 1955

Total catch at 21 stations[1]).

Length (mm.)	Cod	Haddock	Whiting	Saithe
4	—	2	—	—
5— 9	159	374	16	5
10—14	540	880	24	148
15—19	383	268	3	63
20—24	310	146	1	23
25—29	134	60	1	12
30—34	53	24	1	5
35—39	13	12	—	—
40—44	1	3	—	—
Total number	3028[2])	2387[3])	72[4])	266[5])
Number per hour	168	133	4	15
Mean length, mm.	17.3	14.0	12.2	15.7

[1]) On most stations two oblique hauls of 10 minutes at each depth were made with 2 m. ring-trawl (100 — 50 — 25 and 200 — 150 — 125 m. of wire out). In a few cases hauls with 100 — 50 — 25 m. of wire out only were made.

[2]) Including 1435 not measured. [3]) 618 not measured.

[4]) 26 not measured. [5]) 10 not measured.

Faroes

Pelagic 0-Group Cod, Haddock, Whiting, and Saithe

(Figure 3; Table 2)

Stramin-net hauls for pelagic fish larvae were made by the "Dana" in the Faroe region between 5. and 16. June 1955. Samples were collected at 21 stations.

Compared with those obtained on similar investigations in previous years, the average lengths of the cod and haddock larvae obtained in 1955 were high. The numbers of cod caught per hour were normal, but the numbers of haddock were relatively low.

J. S. Joensen

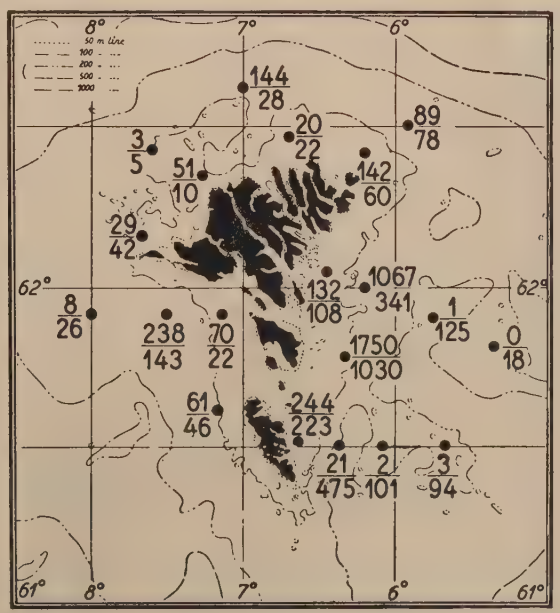

Figure 3. Numbers of larval cod (upper figure) and haddock (lower figure) per hour's haul with 2 m. ring-trawl. June 1955.

Danish Waters

Cod

Kattegat. The following table gives the catch of cod per 1 hour's fishing with the cod trawl. As the 0-group fish, which dominate the later catches, do not appear until the beginning of July, only hauls made after 1. July are taken into account in this table:—

	Number of hauls	Number of fish per hour
N. Kattegat	14	347
S. Kattegat	3	10

It is evident that in the N. Kattegat a rich stock of cod was present, 85—90% of which were 0-group fish. It is of interest to note that the stock seems to be much larger than in 1954, in that year only 45 cod per 1 hour's fishing were caught in that area. In the S. Kattegat the stock of cod found was small, but too few hauls were made to allow a just comparison with the previous year. As in earlier years very few older cod (III-group +) were taken.

Belts. The following table gives the catch of cod per 1 hour's fishing with the cod trawl. As the 0-group cod, which dominate the later catches, do not appear until the beginning of July, only catches made after the 1. July are taken into account in this table:—

	Number of hauls	Number of fish per hour	1954 Number of fish per hour
Belts, N. part	16	833	41
Belts, S. part	35	135	227
W. Baltic	11	319	164

It appears that in the northern part of the Belts and in the western Baltic the catches obtained this year are well in excess of those of the previous year, while in the southern part of the Belts the stock seems to be smaller than that of 1954. In all three areas the older cod (II-group +) are scarce, the 0-group being by far the largest, and often forming more than 90% of the catch. In certain restricted localities conditions may be different, as, for instance, in an area in the southern part of the Belts (Alsfjord) in which commercial trawling is prohibited. The stock sometimes consists mainly of fairly old cod, as was found, for instance, during the investigations in August. Nearly 70% of the catches in that month consisted of II-group fish, while 0-group fish were almost entirely absent.

Very large quantities of 0-group fish are present in some areas and in the northern part of the Belts 5 hauls yielded more than 1000 0-group cod per 1 hour's fishing.

J. Knudsen

Whiting

Kattegat. The cod-trawl hauls with the "Biologen" yielded the following catches of whiting:—

	June	September	November
Number of hauls	14	5	9
Number of fish per 1-hour haul	37	1544	1383

The stock in June was found to consist almost entirely of I-group fish. The enormous increase in the stock which took place between June and September was due to the addition of large numbers of 0-group fish. It may be mentioned that several hauls yielded more than 2000 0-group whiting, and in one haul 3500 fish were taken. The majority of the hauls were carried out in the north-western part of the Kattegat.

In the autumn the 0-group fish formed about 90% of the stock, and the older fish (II-group +) were relatively scarce.

The catches of 0-group fish suggest that the 1955 year-class is about equal to that of 1954; unfortunately, however, too few hauls were made to enable a more precise comparison to be made.

Belts. Experimental hauls made with the cod trawl by the "Biologen" indicated that a considerable influx of 0-group whiting took place during autumn, as appears from the following table:—

	Aug.	Sept.	Oct.	Nov./Dec.
Belts				
Number of hauls ...	12	11	19	8
Number of fish/hour haul	4.2	120	258	126
W. Baltic				
Number of hauls ...	2	—	4	2
Number of fish/hour haul	4.4	—	3.5	392

The table shows that only small quantities of whiting were present in August (this also holds good for the months before August in which fishing was carried out). By September the stock had been increased considerably by the addition of large quantities of 0-group fish. A few hauls made in the western Baltic in December indicated the presence of large numbers of 0-group whiting in that area also. The available figures suggest that more 0-group whiting entered the stock in autumn 1955 than in the previous year.

It should be noted that the few whiting caught during the first half of the year belong mainly to the I-group, while in the second half of the year the most numerous group in the stock are the 0-group. Fish of the II-group and above are scarce, and make up only about 5% of the stock.

J. Knudsen

COMMERCIAL FISH

COD

Greenland Stock

Cod Investigations in the Coastal Waters and on the Offshore Banks of West Greenland in 1955

(Figures 4-5; Tables 3-5a)

1. The age composition

a) Offshore banks

As in previous years large numbers of otoliths were collected and length measurements were made from hand-line catches made by the "Dana" on the banks, from long-line catches made by the "Adolf Jensen", and from Greenland fishing vessels working in inshore waters and in the fjords. Age determinations were made on 6058 otoliths, of which 922 were collected by the "Dana", 2638 by the "Adolf Jensen", and 2498 came from the Greenlanders' catches.

The age analyses of fish caught on the offshore banks are given in Table 3, together with the average lengths of males and females. Figure 4 shows the age compositions of seven catches from the banks (left-hand column). Samples 3 and 6 are from long-line catches made by the "Adolf Jensen". The remaining samples are the "Dana's" hand-line catches. The 1947 year-class predominates in all

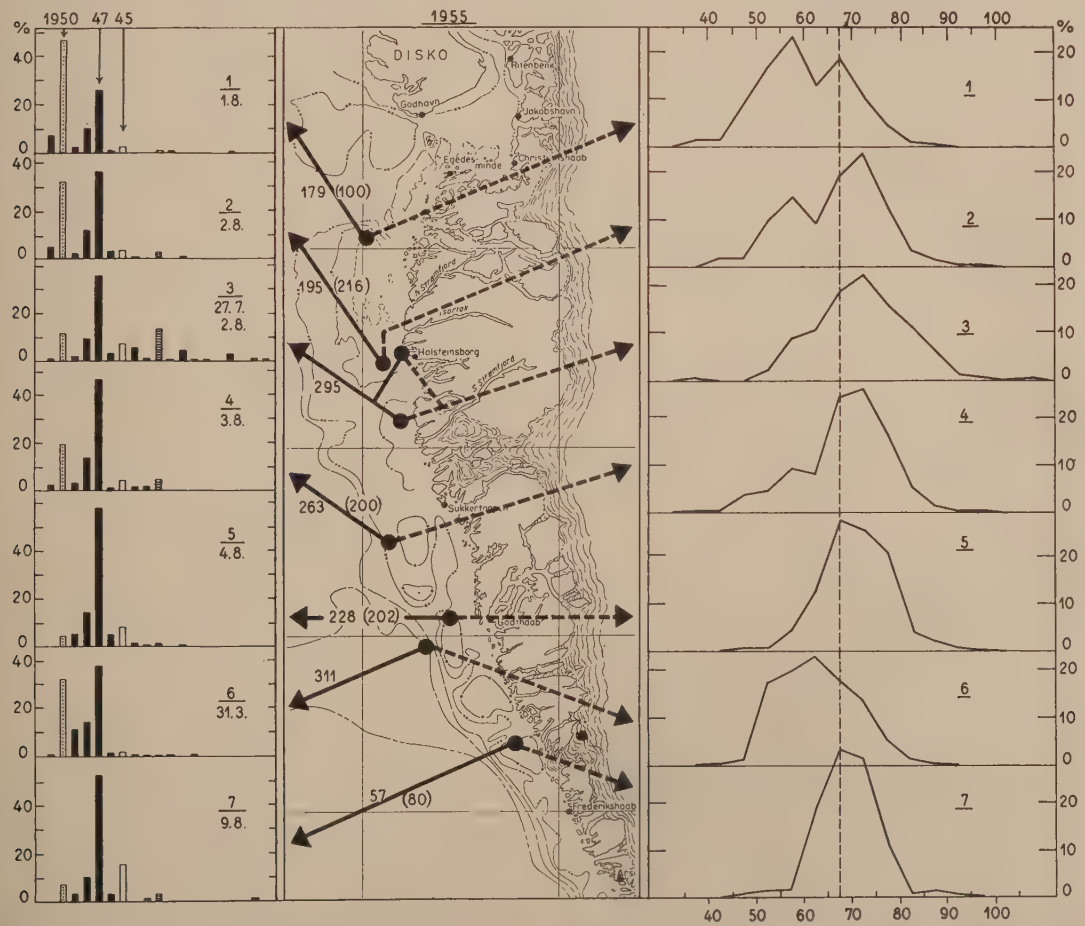

Figure 4. Percentage age distribution (left) and length measurements for 5 cm. groups (right) of cod caught on the Greenland banks in 1955. The numbers of fish examined and of cod tagged (bracketed figures) are given for each station.

Table 3. Percentage Age Composition of the Cod on West Greenland Banks in 1955, together with the Mean Lengths of Males and Females at each Age

Year-class	Age-group	1 Store Hellefiske Bank 68°04′N., 54°54′W. 1. 8., 27—30 m.			2 Store Hellefiske Bank 66°52′N., 54°30′W. 2. 8., 51 m., 3.8°C.			3 Off Holsteinsborg 66°59′N., 54°08′W. 27. 7. and 2. 8.			4 Lille Hellefiske Bank 65°01′N., 54°21′W. 3. 8., 34 m., 2.6°C.		
	Samples	%	Length, cm. ♂♂	♀♀	%	Length, cm. ♂♂	♀♀	%	Length, cm. ♂♂	♀♀	%	Length, cm. ♂♂	♀♀
1951	IV	7.8	44.6	43.5	5.1	46.1	44.7	0.3	—	38.0	2.3	47.0	47.3
1950	V	47.5	54.2	55.0	32.3	56.3	54.9	11.9	54.6	56.8	19.8	58.0	54.9
1949	VI	2.8	63.2	—	2.1	66.0	67.0	2.0	61.7	60.3	3.0	66.4	60.0
1948	VII	10.6	63.9	64.4	12.8	68.1	67.1	9.2	65.8	67.3	13.7	65.5	66.5
1947	VIII	26.3	67.3	70.5	36.9	71.9	71.4	35.9	68.2	70.4	46.8	70.6	73.2
1946	IX	0.6	68.0	—	3.1	70.3	78.5	3.1	66.3	73.2	1.1	72.0	78.0
1945	X	2.2	71.0	76.0	3.6	76.5	88.3	7.1	74.2	75.5	4.9	76.6	77.8
1944	XI	—	—	—	0.5	76.0	—	5.1	80.3	78.3	1.5	75.0	85.3
1943	XII	—	—	—	—	—	—	1.4	81.0	78.0	1.9	78.7	83.5
1942	XIII	0.6	83.0	—	2.6	91.0	85.0	13.2	79.1	82.4	4.9	79.3	81.8
1941	XIV	0.6	—	85.0	—	—	—	0.7	73.0	82.0	—	—	—
1940	XV	—	—	—	1.0	85.0	—	4.7	82.3	87.5	—	—	—
1939	XVI	—	—	—	—	—	—	0.3	—	95.0	—	—	—
1938	XVII	—	—	—	—	—	—	0.7	90.0	106.0	—	—	—
1937	XVIII	—	—	—	—	—	—	—	—	—	—	—	—
1936	XIX	0.6	—	88.0	—	—	—	3.1	80.3	89.8	—	—	—
1935	XX	—	—	—	—	—	—	—	—	—	—	—	—
1934	XXI	—	—	—	—	—	—	1.0	104.0	88.3	—	—	—
Number of fish		179			195			295			263		

Year-class	Age-group	5 Fylla Bank 64°10′N., 52°48′W. 4. 8., 45 m., 2.0°C.			6 Fylla Bank 63°53′N., 53°22′W. 31. 3., 200 m., 1.1°C.			7 Dana Bank 62°45′N., 51°09′W. 9. 8., 55 m., 1.1°C.		
		%	Length, cm. ♂♂	♀♀	%	Length, cm. ♂♂	♀♀	%	Length, cm. ♂♂	♀♀
1951	IV	—	—	—	0.3	—	41.0	—	—	—
1950	V	4.8	63.0	58.4	32.1	54.6	54.1	7.0	52.3	58.0
1949	VI	5.2	64.0	65.6	11.2	58.4	59.5	3.5	63.5	—
1948	VII	14.4	66.0	67.6	14.7	63.1	63.1	10.5	62.3	66.3
1947	VIII	57.7	71.5	72.6	37.2	66.1	68.7	52.6	66.6	72.4
1946	IX	5.2	75.3	79.5	1.2	68.0	79.5	3.5	65.0	79.0
1945	X	8.3	79.8	76.0	1.6	78.0	77.0	15.8	70.0	74.0
1944	XI	1.3	79.0	90.0	0.3	78.0	—	—	—	—
1943	XII	0.9	83.0	90.0	0.3	—	77.0	1.8	73.0	—
1942	XIII	1.3	—	91.7	0.3	74.0	—	3.5	74.0	77.0
1941	XIV	—	—	—	0.3	—	82.0	—	—	—
1940	XV	0.4	—	75.0	—	—	—	—	—	—
1939	XVI	—	—	—	0.3	—	78.0	—	—	—
1938	XVII	—	—	—	—	—	—	—	—	—
1937	XVIII	—	—	—	—	—	—	—	—	—
1936	XIX	0.4	—	100.0	—	—	—	—	—	—
1935	XX	—	—	—	—	—	—	—	—	—
1934	XXI	—	—	—	—	—	—	1.8	—	89.0
Number of fish		228			311			57		

the samples, except No. 1 which comes from the northernmost station.

The second best year-class was that of 1950, which made up 47.5% of the catch from the northern part of Store Hellefiske Bank. In the same month in 1954 it amounted to between 25 and 30% of the catches in this locality. The higher proportion in the 1955 catches results from the growth of the fish in the intervening year. The mean over-all length of the cod of the 1950 year-class was 55.8 cm. in 1955, and it is at that length that cod usually appear in commercial catches. The 1950 year-class was present in fair numbers (32.3% in sample No. 2) on the southern part of Store Hellefiske Bank. In sample No. 3 it amounted only to about 12% since this sample was from a long-line catch in which large

halibut hooks were used, and obviously such gear is not very suitable for taking small cod. In samples Nos. 5 and 7 there were very few cod of the 1950 year-class, although this was very strongly represented (32.1%) in sample No. 6, a long-line catch made in early spring on Fylla Bank. Year-classes older than that of 1947, for instance the formerly rich 1942 and 1945 year-classes, were only very sparsely represented in the catches on the banks. In sample No. 7 (from the southernmost position) of the seven samples described in Figure 4 and Table 3 the 1945 year-class amounts to only little more than 15% of the whole sample, and in all the other samples it is less than 10%. The 1942 year-class is very scarce in all samples except No. 3, which is the sample taken by halibut hooks on a long-line, and the preponderance of such an elderly year-class must be ascribed to the large hooks.

The graphs in Figure 4 showing the length frequencies of cod by 5-cm. groups agree with the age analyses. The two peaks on the graphs (55—60 cm. and 65—75 cm.) represent the two predominant year-classes, 1947 and 1950.

Our investigations indicate that in 1955 the stock of cod on the banks consisted mainly of two year-classes. The most prominent year-class in the banks fishery was the 1947 year-class, of which the mean length in 1955 was between 68 and 72 cm., corresponding to a mean weight of 3 to 3.5 kg. The next most numerous year-class was that of 1950, but these fish were still small (mean length 54—58 cm.; mean weight 1.4—1.7 kg.) and were consequently of very little value to the commercial fishery.

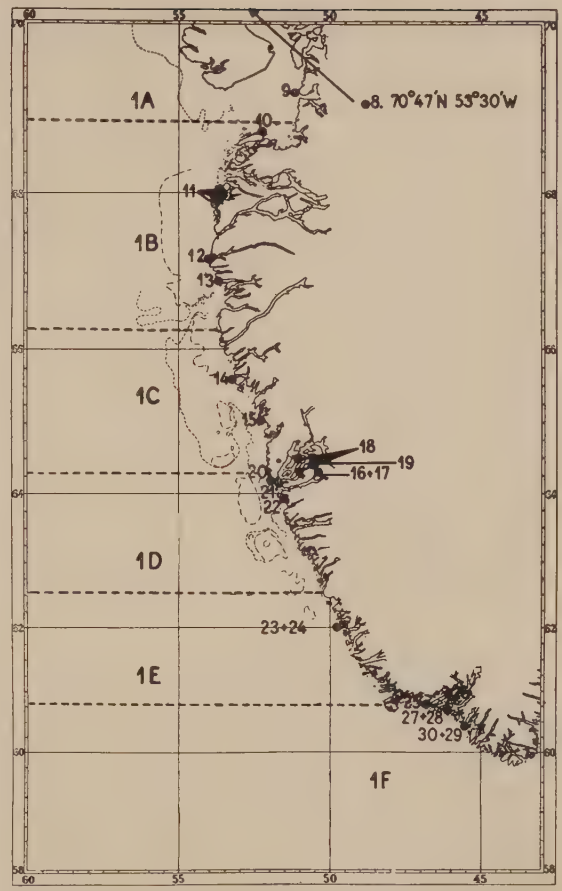

Figure 5. Localities at which otolith samples were collected for age analyses. The numbers correspond with those given in Table 4.

b) Inshore waters and the fjords.

Table 4 gives the results of 4730 age determinations made with otoliths from samples from the inshore waters and the fjords. The samples come from all the sub-areas from 1A to 1F (Figure 5). Most of them were from catches made with cod hooks on long-lines. Samples 12, 14 and 25 were taken on a long-line on which two-thirds of the hooks were cod hooks and one-third halibut hooks, Nos. 16 and 17 came from pound-net catches and No. 22 from a shrimp-trawl catch. In the two samples from sub-area 1 A (Nos. 8 and 9) 1942 (XIII) was the predominant year-class and the 1934 (XXI) and 1936 (XIX) year-classes were more numerous than in samples from other sub-areas. It is a common phenomenon that rich year-classes continue to appear in the catches in sub-area 1A for several years after they have almost disappeared from the catches in the southern sub-areas. The rich 1947 year-class predominated in the samples from sub-areas 1B and 1C (Nos. 10—15), except in sample No. 13, in which the 1950 year-class was most numerous at 46.2%. The samples from sub-area 1 D were from the inner part of Godthåb Fjord (Nos. 18—19), from the waters just off the entrance to this fjord (Nos. 20—22), and from the inner part of Ameralik Fjord (Nos. 16—17). The last samples were from pound-net catches, and accordingly the age composition showed a large number of small codling, mainly of the 1950 year-class. In the winter and early spring samples (Nos. 18 and 21) from Godthåb Fjord, just taken before and during the spawning period, 49.4% of the cod were of age-group XV (1940) and 48.9% were still older fish; the 1940 year-class has been prominent in the catches over a period of years. Year-classes younger than 8 years old occurred in small numbers, mostly in sample No. 18. The September sample from Godthåb

Table 4. Percentage Age Composition from Inshore Waters and the Fjords of West Greenland in 1955

Year-class	Samples Age-group	8 Sept.	9 Sept.–Oct.	10 Aug.–Sept.	11 Aug.–Sept.	12 July	13 June–July	14 Aug.	15 Sept.	16 May	17 June	18 Feb.–Apr.	19 Sept.
1951	IV	—	—	—	—	—	1.5	—	—	15.7	4.4	0.1	7.2
1950	V	—	—	0.5	21.2	5.3	46.2	3.9	1.6	31.0	34.2	2.0	10.8
1949	VI	—	—	1.0	4.9	—	18.1	1.3	—	8.5	7.6	2.0	7.2
1948	VII	—	—	2.6	10.3	8.0	12.1	5.2	2.4	5.1	3.2	0.7	3.6
1947	VIII	15.5	7.5	52.3	55.6	50.7	21.6	35.0	22.8	10.9	19.6	6.8	18.0
1946	IX	2.1	1.3	2.1	1.1	1.3	0.5	1.3	1.6	1.0	2.5	0.9	1.8
1945	X	12.4	11.3	15.0	3.7	10.7	—	10.4	11.0	8.2	12.7	12.6	33.3
1944	XI	3.1	2.5	2.6	0.6	4.0	—	3.9	2.4	0.3	1.3	1.7	2.7
1943	XII	7.7	6.3	3.1	1.1	8.0	—	5.2	3.1	0.3	1.3	3.6	4.5
1942	XIII	33.0	37.5	13.0	1.4	9.3	—	23.4	33.1	4.1	3.8	17.8	8.1
1941	XIV	6.7	7.5	2.1	—	—	—	1.3	3.1	1.0	—	2.1	—
1940	XV	7.7	7.5	3.1	—	—	—	6.5	11.8	7.5	5.1	24.0	2.7
1939	XVI	3.6	1.3	—	—	—	—	—	0.8	0.3	0.6	3.1	—
1938	XVII	—	1.3	0.5	—	—	—	—	—	5.1	2.5	13.7	—
1937	XVIII	0.5	2.5	0.5	—	—	—	—	2.4	—	—	1.6	—
1936	XIX	4.6	3.8	1.6	—	—	—	—	—	0.3	—	5.9	—
1935	XX	—	—	—	—	—	—	—	3.9	0.3	—	0.3	—
1934	XXI	3.1	5.0	—	—	2.7	—	2.6	—	—	1.3	0.8	—
1933	XXII	—	3.8	—	—	—	—	—	—	—	—	—	—
1932	XXIII	—	1.3	—	—	—	—	—	—	—	—	—	—
Total number		194	80	193	788	75	199	77	127	293	158	745	111

Year-class	Age-group	20 Sept.	21 May	22 Oct.	23 July–Aug.	24 Oct.	25 Aug.–Sept.	26 Sept.	27 Apr.–May	28 June	29 Aug.	30 Oct.
1951	IV	24.7	2.3	11.5	1.0	1.0	—	—	—	8.0	3.0	4.6
1950	V	47.8	6.8	36.8	24.0	8.5	—	4.0	5.7	44.8	44.6	18.3
1949	VI	8.0	3.4	11.5	40.5	14.0	—	2.7	5.7	22.4	32.6	15.2
1948	VII	1.8	1.1	4.6	6.0	4.5	—	1.3	6.5	0.8	5.1	4.1
1947	VIII	10.6	8.0	25.3	19.5	37.0	34.9	22.7	18.7	18.4	12.1	38.1
1946	IX	—	1.1	1.1	1.0	0.5	—	1.3	—	—	—	1.0
1945	X	—	6.8	6.9	3.5	12.5	22.9	32.0	49.6	5.6	2.5	13.2
1944	XI	—	2.3	—	0.5	—	1.2	5.3	2.4	—	—	1.0
1943	XII	1.8	—	1.1	1.5	3.0	1.2	4.0	—	—	—	—
1942	XIII	2.7	17.0	—	1.5	8.0	18.1	14.7	9.8	—	—	1.5
1941	XIV	0.9	2.3	—	—	0.5	2.4	1.3	—	—	—	—
1940	XV	0.9	36.4	1.1	0.5	2.0	8.4	1.3	1.6	—	—	2.0
1939	XVI	—	3.4	—	—	1.5	1.2	4.0	—	—	—	1.0
1938	XVII	—	5.7	—	—	2.0	3.6	1.3	—	—	—	—
1937	XVIII	—	—	—	—	0.5	—	—	—	—	—	—
1936	XIX	0.9	2.3	—	—	2.5	3.6	1.3	—	—	—	—
1935	XX	—	—	—	—	0.5	—	—	—	—	—	—
1934	XXI	—	1.1	—	0.5	1.5	2.4	2.7	—	—	—	—
Total number		113	88	87	200	200	83	75	123	125	199	197

Fjord (No. 19) is quite different from the samples taken in winter and in spring. Fish of age-group XV (1940) were the oldest present and amounted to 2.7% of the total. The 1945 year-class predominated, at 33.3%. The two samples obtained from the open sea in September and October (Nos. 20 and 22) were very similar to each other; in both of them 1950 was the predominant year-class and was followed in order of magnitude by that of 1947. In sub-area 1E only two samples were collected; these relate to July—August and October respectively. In sample No. 23 the 1949 year-class predominated, at 40.5%, while the 1950 year-class was the second best. In sample No. 24 the 1947 year-class predominated, at 37%, and was followed by the 1949 year-class, at 14%. The yield of the commercial fishery in sub-area 1 E consisted mainly of small cod, which suggests that the 1949 and 1950 year-classes were very strongly represented. In this sub-area, however, the pound-net fishery is very important in spring and in early summer.

Samples Nos. 25—30 are from catches in sub-area 1 F. They differ very much amongst themselves in regard to age composition. As may be seen, 1950

Table 5. Marked Cod recaptured at Greenland (Gr.) and at Iceland (Ic.) in 1955, tabulated according to Age and Year of Liberation

Year-class	Age-group	1949		1950		1951		1952		1953		1954		1955		Total		
		Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	%	Ic.
1934	XXI	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	0.3	—
1935	XX	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1936	XIX	—	—	—	—	—	—	2	—	—	—	1	—	1	—	4	1.2	—
1937	XVIII	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1938	XVII	—	—	—	—	—	—	—	—	—	—	4	—	3	—	7	2.2	—
1939	XVI	—	—	—	—	—	—	1	—	—	—	3	—	—	—	4	1.2	—
1940	XV	1	—	—	—	—	—	5	—	2	—	17	—	10	—	35	10.8	—
1941	XIV	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1942	XIII	1	—	1	—	2	—	6	1	2	—	19	1	2	—	33	10.2	2
1943	XII	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	0.3	—
1944	XI	—	—	—	—	—	—	2	—	—	—	3	—	—	—	5	1.5	—
1945	X	1	1	1	—	1	3	7	6	8	5	18	6	2	—	38	11.7	21
1946	IX	—	—	—	—	—	—	—	1	—	—	2	—	—	—	2	0.6	1
1947	VIII	—	—	—	—	1	—	7	—	11	—	57	3[1]	13	—	89	27.5	3[1]
1948	VII	—	—	—	—	1	—	1	—	1	—	4	—	4	—	11	3.4	—
1949	VI	—	—	—	—	—	—	—	—	1	—	3	—	10	—	14	4.3	—
1950	V	—	—	—	—	—	—	—	—	1	—	7	—	51	—	59	18.2	—
1951	IV	—	—	—	—	—	—	—	—	—	—	—	—	18	—	18	5.6	—
1952	III	—	—	—	—	—	—	—	—	—	—	—	—	3	—	3	0.9	—
??		1	1	4	1	5	2	29	1	39	1	123	—	22	—	223	—	6
Total number		4	2	6	1	10	5	60	9	65	6	263	10[1]	139	—	547	—	33[1]

[1]) 1 cod recaptured in the Barents Sea.

and 1949 are the predominant year-classes in samples 28 and 29 and they are the second and third most numerous groups in sample 30. The occurrence of fairly large quantities of small cod in commercial catches suggests that the young fish of these two year-classes contributed considerably to the yield of the fishery in this locality just as they did in sub-area 1E. It must be mentioned, however, that there is no pound-net fishing in sub-area 1F, as there is in sub-area 1E. The 1945 year-class which was well represented in the catches in sub-area 1F until 1954, was most numerous in only two samples (Nos. 26 and 27) in 1955, and the 1947 year-class, which was previously much less numerous here than in the northern sub-areas, predominated in two samples (Nos. 25 and 30). Year-classes later than 1945 were very poorly represented in all samples except Nos. 25 and 26.

2. Tagging experiments

In 1955, 2496 cod were tagged, 798 on the offshore banks by the "Dana" and 1688 at sea and in the fjords by the "Adolf Jensen", the "Tornaq", and the "Immanuel".

580 recaptures were reported. The recoveries of the marked fish of different ages are given in Table 5. There were 547 recaptures in West Greenland waters, 32 in Icelandic waters, and 1 in the Barents Sea. In addition, one was made by a Portuguese fishing vessel in the Newfoundland area. This remarkable recapture is supported by the recapture of another cod liberated in the same area off Greenland in 1954. The latter recapture, which was reported and confirmed in 1955, was of a cod tagged off Sydprøven, 60°26'N., 45°35'W., sub-area 1 F, on 20. September 1951, and recaptured by a Newfoundland trawler in Conception Bay, Newfoundland, sub-area 3L[1]) on 20. November 1954. When tagged the fish was 63 cm. long and probably belonged to the 1945 year-class, being therefore 9 years old when recaptured. This is the first reported recapture of a tagged Greenland cod in the Newfoundland area. The cod recaptured in the Barents Sea was tagged off Nanortalik, 60°08'N., 45°28'W., sub-area 1F, 9. September 1954. The plastic tag was found when the cod was landed from a German trawler. It was reported that the fish must have been taken off Röst or Malangen or on Skolpen Bank in December 1955, after it had been about 15 months at liberty. It was male, 8 years old, 1947 year-class, and had just reached maturity. This is the second tagged cod recaptured in the Barents Sea in the last two years. This year, 1956, another remarkable recapture was made by a German trawler on the newly discovered Anton Dohrn Bank between East Greenland and Iceland, 65°45'N., 30°00'W., on 7. February 1956. The cod

[1]) I.C.N.A.F.'s sub-divisions.

Table 5a. Numbers of Recaptures of Fish marked before 1955 in different Localities

(Figures in brackets refer to the cod recaptured in the same locality as that in which they were liberated)

Area of tagging	Area of recapture: Offshore banks	Inshore waters	Fjords	Iceland	Total
Offshore banks	213 (70)	1	—	9	223
Inshore waters	37	32 (16)	16	22	107
Fjords	12	15	77 (18)	1	105

was tagged at position 60°14'N., 45°31'W. on 17. September 1953. It was a male, 64 cm. long when tagged and 73.5 cm. when recaptured. It belonged to the 1945 year-class and had reached maturity when 9 years old. All these recaptures, two from the Barents Sea, two from Newfoundland, and one from the Anton Dohrn Bank, suggest a wider dispersal of the cod from the Greenland area than was formerly believed.

Of the 32 cod recaptured in Icelandic waters, 22 were tagged in sub-area 1 F, 2 on the Dana Bank, 4 on Fylla Bank, and 1 on each of the following banks: Fiskenæs Bank, Banana Bank, Lille Hellefiske Bank, and Store Hellefiske Bank.

Many long migrations are known to have been made by cod within the Greenland area itself both northwards and southwards. Of special interest are the comparatively large numbers of migrations from inshore waters and the fjords out to the offshore banks; it is noteworthy that there has been only one in the reverse direction, from the offshore banks to the inshore waters and fjords. It seems that the stock of cod on the banks is recruited mainly from cod which have grown up in inshore waters and in the fjords (see Table 5 a)

The proportions of the different year-classes (age-groups) in the recaptures are given in Table 5.

Otoliths were collected for age determination in 351 recaptured cod. As in 1954, the great majority of the cod recaptured in Icelandic waters belonged to the 1945 year-class (X-group). The 1947 year-class (VIII-group) is represented by two recaptures off Iceland and one from the Barents Sea. This means that the 1947 year-class has now reached maturity and some of the individuals have emigrated to distant spawning grounds. It will be interesting to see whether fish of this rich year-class will emigrate in increasing numbers in the coming years.

The age composition of the fish recaptured in Greenland waters shows the predominance of the 1947 year-class, as was to be expected. The 1950 year-class appears as the next most numerous year-class, and the 1945, 1942, and 1940 year-classes are nearly equally represented. The comparative abundance of the latter year-class is due to the fairly large number of recaptures from Godthåb Fjord, the only locality in which cod of the 1940 year-class occur in large numbers.

Cod recaptured in 1955

	Greenland	Iceland	Barents Sea
Denmark	1	—	—
Greenland	244	—	—
Faroe Islands	6	—	—
Norway	16	—	—
Iceland	7	27	—
United Kingdom	3	1	—
France	3	—	—
Germany	4	4	1
Portugal	259	—	—
Total	543	32	1

The table above gives the numbers of recaptures reported by different countries. As in 1953 and 1954, most of the recaptures were reported by Portuguese and Greenland fishermen. It may be seen that Portugal reported not less than 259 recaptures in the West Greenland area. This must be the result of the excellent organization Portugal has developed for collecting information about recaptures of tagged cod. It would be appreciated if other nations who fish to any considerable extent in West Greenland waters could set up similar organizations. If that were done, much more valuable results would come from the tagging experiments. As the situation is at present, it must be assumed that many fishermen keep the tags from recaptured cod as souvenirs or amulets, or else throw them away.

P. M. Hansen

English Tagging Experiments

(Table 6)

In September 1952, 256 cod were tagged in the Cape Farewell area by means of Lea tags with single ended stainless steel wire bridles.

Small numbers of recaptures have been made each year and during 1955 the total reached 24. Of these,13 were returned from Greenland and 11 from Iceland. Of the former, 9 were returned between September and December 1952, and had been at liberty for periods of between 2 and 82 days, and 1 after 322 days. They had moved only a few miles from their release position. The remaining 3 were recovered in positions approximately 120, 300 and nearly 600 miles north of Cape Farewell as follows. (i) North of Cape Desolation on 15. October 1955 (after 1,129 days), (ii) N.E. edge of Fiskenæs Bank on 14. May 1955 (after 981 days), (iii) N. edge of Store Hellefiske Bank on 14. July 1955 (after 1,046 days). Details of the Icelandic return are given in Table 6.

Table 6

	Release position N.	W.	Recapture position	Length, cm. Libs.	Recap.	Date of capture	Days at liberty
1	59°40½′	44°05′	Eldeyjar Bank S.W. Iceland	69	75	15.–27. April 1953	222
2	61°45½′	41°47′	Isafjord Deep N.W.Iceland	82	83	12. May 1953	238
3	59°40½′	44°05′	66°43′ N. 23°15′ W.	64	?	15. July 1953	307
4	59°43′	45°04′	42′ E. ½ N. of Langanes	70	77	22. June 1954	649
5	59°40½′	44°05′	66°40′ N. 24°41′ W.	67	?	25. November 1954	805
6	59°40½′	44°05′	W.S.W. of West Light Selvogsnes	81	95.7	4. March 1955	904
7	59°43′	45°04′	64°04′ N. 15°49′ W.	70	89	24. March 1955	925
8	59°40½′	44°05′	64°10′ N. 23°30′ W.	80	92.6	19. April 1955	950
9	59°40½′	44°05′	63°46′ N. 21°40′ W.	73	?	22. April 1955	953
10	59°43′	45°04′	Off Snaefellsnes N.W. Iceland	66	82	19. May 1955	981
11	59°43′	45°04′	West side of Isafjord Deep	66	76	23. May 1955	985

G. C. Trout

German Investigations

(Table 7)

In 1955 German fishing in Greenland, which started in 1952, increased extraordinarily. Since the discovery of large fish shoals on the Dohrn Bank (East Greenland; 65°45′N., 29°30′W.) by the German research ship "Anton Dohrn", German vessels now fish the waters of West, South, and East Greenland. The annual catch rose to 66,744 tons (1952—1954: 1,137 to 2,455 tons). Most of the catch consisted of redfish (83%), cod amounting to 9,041 tons (13.5%).

German vessels began fishing for cod on Fiskenæs and Fylla Bank in early May and continued until early July, when the cod disappeared from the

Table 7. Composition by Length and Age of the Cod in West, South, and East Greenland in 1955 (‰)

	West Greenland			South Greenland		East Greenland		
	Trawler	"Anton Dohrn"		Trawler	"Anton Dohrn"	Trawler	"Anton Dohrn"	
	Fiskenæs + Fylla	Noname-Fylla	L. + St. Hellef. Bank	Farewell	Farewell + Sermersok	Dohrn Bank	Dohrn Bank south	Dohrn Bank north
	V—VII	IX	IX	XII	IX—X	X—XI	IX	IX
Length (cm.)								
20— 24	—	3	—	—	2	—	—	—
25— 29	—	17	—	—	3	—	—	—
30— 34	—	50	7	—	7	—	—	—
35— 39	—	74	21	—	21	—	—	—
40— 44	—	173	28	2	63	—	—	—
45— 49	4	148	52	29	146	—	—	—
50— 54	30	118	82	101	205	—	—	—
55— 59	72	93	60	206	144	5	30	—
60— 64	202	63	142	124	109	6	8	—
65— 69	297	54	229	87	80	17	122	29
70— 74	213	38	225	86	56	44	99	30
75— 79	103	38	103	107	50	76	176	147
80— 84	52	37	34	158	63	154	237	265
85— 89	20	30	13	61	35	216	130	323
90— 94	5	29	2	25	12	206	122	118
95— 99	2	15	2	9	3	131	46	59
100—104	—	10	—	3	1	89	15	29
105—109	—	5	—	2	—	34	15	—
>109	—	5	—	—	—	22	—	—
Year-class								
1953	—	17	—	—	6	—	—	—
1952	—	108	34	—	26	—	—	—
1951	—	243	56	7	45	4	46	—
1950	66	289	172	240	396	19	55	—
1949	102	96	26	182	198	85	294	—
1948	81	6	70	13	13	29	18	—
1947	509	87	457	173	131	58	73	29
1946	36	4	25	14	8	19	0	30
1945	104	105	107	285	156	589	441	882
before 1945	102	45	53	86	21	197	73	59

banks. Thanks to the presence of large shoals of cod, the average daily catch by the trawlers rose in June to 32 tons. The cod fishery in the South Greenland area was less successful (the average daily catch in December was 15.6 tons). Cod contributed only little to the new East Greenland fishery (not more than up to 3 tons a day).

Table 7 gives the composition by age and length of commercial catches and also of those made by the "Anton Dohrn".

The success of the West Greenland cod fishery in the early summer of 1955 was due to the strong 1947 year-class (the average length of these fish was 68.5 cm. in June and 69.2 cm. in September). The 1945 year-class is still of commercial importance, especially in the south. Most of the cod over 10 years old belong to the 1942 year-class. The new rich year-class of 1950, which is now entering the fishery as 5-year-old fish, is of good strength both south and west of Greenland. The "Anton Dohrn's" catches again revealed the fact that the 1949 year-class is mainly present on southern grounds, just as was the interesting 1945 year-class some years ago. Possibly a large part of this 1949 year-class is of Icelandic origin and will perhaps go back to Iceland for spawning at the end of 1956. Thus the 1949 year-class, together with that of 1950, may provide the fish for a new Farewell fishery in the autumn of 1956, similar to that in 1952 but perhaps not quite so successful.

The year 1955 was very cold in South and West Greenland, and there was a long period in which little or no fishery took place. Even in October the "Anton Dohrn" met several icebergs and frequently had to reduce speed to pass through fields of innumerable icebergs, especially in the vicinity of Julianehåb and Sermersok. Few cod were caught from Noname Bank up to Store Hellefiske Bank, either on the banks or on the slopes. The banks were covered with water of temperatures below 2°C. Water of 3°C. was found only on the northern part of Store Hellefiske Bank. The 1955 hydrographic situation was characterized by the marked influence of the East Greenland current, and relating this to the poor catches of cod in September and the large catches by French and Faroese trawlers on the northern flat parts of Store Hellefiske Bank which began suddenly in early October, we may conclude that the mass of cod which suddenly disappeared from Fylla Bank in July migrated at that time far to the north and perhaps to the warmer coastal waters.

The age composition of the cod off East Greenland shows that large numbers of the 1945 year-class, which disappeared in 1952 from the Farewell area, are still living in East Greenland waters. Many of them exhibit no spawning zones. Cod marked off South Greenland were caught on the Dohrn Bank. Besides very old cod (many 13 years old), we found the rich 1949 year-class from Iceland on this new fishing ground, especially on the southern and warmer parts of the bank. On the other hand, of a small catch of cod made by the "Anton Dohrn" north of the bank in the cold arctic water of the East Greenland current, 86% proved to be of the 1945 year-class.

From other catches made by the "Anton Dohrn" we may conclude that the cod in East Greenland waters originate from both West Greenland (1947 and 1950 year-classes) and Iceland (1945 and 1949 year-classes).

ARNO MEYER

Icelandic Stock

The Stock of Spawning Cod in 1955

(Table 8)

The age composition of the spawning cod in 1955 is shown in Table 8. The figures are based on the age analyses of 4367 mature cod caught on long-lines off the south and south-west coasts of Iceland during the months January—May.

Table 8. The Composition of the Stock of Spawning Cod in 1955

Age-group	Age at first spawning 3	4	5	6	7	8	9	10	11	12	13	Total
III	16	—	—	—	—	—	—	—	—	—	—	16
IV	—	96	—	—	—	—	—	—	—	—	—	96
V	—	7	183	—	—	—	—	—	—	—	—	190
VI	—	—	142	614	—	—	—	—	—	—	—	756
VII	—	—	16	192	385	—	—	—	—	—	—	593
VIII	—	—	—	7	215	444	—	—	—	—	—	666
IX	—	—	—	2	14	147	293	—	—	—	—	456
X	—	—	—	2	39	421	1855	3694	—	—	—	6011
XI	—	—	—	—	9	32	119	211	156	—	—	527
XII	—	—	—	—	9	27	50	89	105	21	—	301
XIII	—	—	—	—	14	71	71	62	44	48	5	315
XIV	—	—	—	—	—	7	7	—	—	2	—	16
XV	—	—	—	—	2	2	—	—	—	2	—	6
XVI	—	—	—	—	5	2	2	—	2	—	—	11
XVII	—	—	—	—	—	—	—	2	2	—	—	4
XVIII	—	—	—	—	—	2	2	—	2	—	—	6
XIX	—	—	—	—	—	2	7	2	2	—	—	13
XX	—	—	—	—	—	2	2	2	2	2	—	10
XXI	—	—	—	—	—	—	—	2	—	—	—	2
Total:	16	103	341	817	692	1159	2408	4064	315	75	5	9995

Spawning classes

1	2	3	4	5	6	7	8	9	10	11	12	13	Total
5907	2922	712	187	109	89	23	8	8	11	11	6	2	9995

The 1945 year-class still dominates the catches, constituting about 60% of the cod caught. The composition of this year-class is of a rather peculiar and unusual nature. It became mature much later than usual; 61.5% of the fish in it were spawning for the first time as 10-year-old fish, compared with the normal proportion of 29.4% for this age-group.

There is a great predominance of first-time spawners, which number 5907 out of 10,000 as compared with the normal number of 3821. The 1945 year-class provides the bulk of the recruits (62.5%). The normal proportion for this age-group among the recruits is 14.3%.

JÓN JÓNSSON

German Investigations

(Table 9)

In 1955 German vessels caught 38,900 tons of cod. Of these, 18% were caught in the south-western area and 72.9% in the north-western. In spite of the fact that in contrast to previous years there was only little fishing N.W. of Iceland from September to December in 1955 (owing to the new fishery at East Greenland), the proportion of cod caught rose from 19.0% to 25.8%.

Compared with 1953 and 1954 the cod on the south-western spawning grounds were of greater average length. Age determinations again revealed the extraordinary predominance of the strong 1945 year-class with 750‰ (818‰ in 1954). The average length of this 10-year-old cod is now 84.1 cm.

On the feeding grounds north-west of Iceland the average daily catch rose from 5.3 tons to 8.5 tons. Whilst the proportion of the 1945 year-class dropped from 528‰ to 360‰, the younger year-classes of 1949 (average length 73.5 cm.) and 1950 (average length 64.1 cm.) gradually gained in importance. The commercial value of these younger year-classes, however, is not yet very high, as the combined age and weight analysis demonstrates; 24,000 tons (25,000 tons in 1954), that is, 62% of the total German catch of cod, consisted of cod of the 1945 year-class. The share of the 1949 year-class is only 6,800 tons or 17.8% (in 1954 it was 2,700 tons, or 7.5%) and that of the 1950 year-class, 3,500 tons, or 8.9%.

ARNO MEYER

Arcto-Norwegian Stock

English Cod Tagging in 1954 and 1955

(Table 10)

The tagging of cod in the Barents Sea was begun in 1951 during one cruise of the "Ernest Holt" and was continued for a further cruise in 1952 in order to determine the migrations of cod on, and away from, the Spitsbergen Bank. A total of 7,357 were released in the two cruises.

During 1954 and 1955, however, cod were tagged as part of a joint Anglo-Norwegian study of growth and mortality and a further 6,605 were released in small batches, well spread over the bank, during each cruise to the area. Lea tags alone were used and were attached to the cod's dorsal musculature between DI and DII by means of yellow monofilament nylon loops—2,995 in 1954 and 2,604 in 1955.

The total number of the 1954 releases recaptured in their first year at liberty was 98, whilst a further 24 were taken up to the end of the year.

Their percentage recapture per 5 cm. length-group is shown in Table 10 and is based on lengths at release and for all gears.

Cod tagged during 1955 have not yet completed their first year at liberty but the total number returned (March 1956) and their percentage return

Table 9. Composition by Length and Age of Cod taken by German Vessels S.W. and N.W. of Iceland in 1955 (‰)

Length, cm.	S.W.	N.W.
45— 49	—	4
50— 54	1	25
55— 59	1	52
60— 64	5	95
65— 69	23	126
70— 74	89	147
75— 79	190	164
80— 84	252	159
85— 89	218	125
90— 94	111	60
95— 99	45	29
100—104	18	11
105—109	15	2
110—114	10	1
>114	22	—

Year-class	S.W.	N.W.
1952	—	2
1951	—	44
1950	3	188
1949	34	247
1948	17	59
1947	37	50
1946	9	6
1945	750	360
before 1945	150	44

Table 10. Percentage Recaptures per 5 cm. Length-Groups

Year 1954	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-99	100-104	105-109	110-114	115-119	120-124	125-129	130-134
Number released	1	16	104	346	506	467	409	413	376	179	84	48	26	10	3	3	3	1	—	—	—
Number returned	—	—	2	—	12	9	11	22	23	9	—	7	2	—	—	—	—	—	—	—	—
% per length-group	0	0	1.9	0	2.4	1.9	2.7	5.3	6.1	5.0	0	14.6	7.7	0	0	0	0	0	—	—	—
Year 1955																					
Number released	—	5	32	134	494	913	738	401	272	254	155	79	58	24	24	11	6	2	1	—	1
Number returned	—	—	—	1	5	20	16	6	6	9	2	3	1	2	1	—	—	—	—	—	—
% per length-group	—	0	0	0.7	1.0	2.2	2.2	1.5	2.2	3.5	1.3	3.8	1.7	8.3	4.2	0	0	0	0	—	0

per length-group is also shown. It will be seen that there is an increase in percentage recapture with length.

An interesting feature of returns from the 1951 and 1952 releases has been the increasing importance of the south-east Barents Sea, i.e., east of North Cape, as a source of returns of large fish, which by their size in comparison with other returns from the Lofotens, must be regarded as mature. Very few of the larger length-groups are returned from the Spitsbergen Bank. This recalls the earlier Norwegian results from Lofoten releases, when the bulk, over 70%, of recaptures away from the Lofotens, came from the S.E. Barents Sea. It must be assumed, therefore, that the Norwegian figures reflect a real difference in distribution of matures and are not the effect of differences in return of tags.

G. C. Trout

German Landings

(Table 11)

The landings of all fish by German vessels from the north-eastern area rose from 64,140 tons in 1954 to 92,259 tons in 1955; those of cod rose from 17,288 tons (27.0%) to 27,003 tons (29.3%). The increase was due to greater fishing activity in the Lofotens. The weight of cod caught nearly doubled and the average daily catch rose from 2.3 to 3.0 tons. Compared with 1954, the cod were of greater average length. In contrast with 1954, in which there was a high proportion (632‰) of the 1946 and older year-classes, there was in 1955 a clear predominance of the younger year-classes of 1947, and especially 1948, which made up 656‰ of the catch.

In the Bear Island area and the Barents Sea a new rich year-class entered the fishery. Fish of this, the 1950 year-class, had an average length of 60 cm. and predominated in the catches to the extent of 69%. In consequence the average length of the catch as a whole dropped from 66.5 to 63.6 cm. The average daily catch in the Barents Sea and the Bear Island area, however, was almost the same as in the preceding year.

Table 11. Age and Length Composition of the Cod landed by German Vessels from the North-Eastern Fishing Grounds in 1955 (‰)

Length, cm.	Norwegian coast Feb.—Apr.	Barents Sea Nov.—Jan.	Bear Island Dec.
45— 49	—	26	4
50— 54	—	127	104
55— 59	10	245	274
60— 64	45	249	357
65— 69	108	148	155
70— 74	146	90	70
75— 79	169	49	17
80— 84	149	29	10
85— 89	135	22	5
90— 94	99	9	2
95— 99	65	3	1
100—104	40	2	1
105—109	19	1	—
>109	15	—	—
Year-class			
1951	—	45	60
1950	15	619	690
1949	41	139	175
1948	380	180	69
1947	276		
1946	60	17	6
1945	133		
before 1945	95		

Arno Meyer

The Finnmark Spring Cod

(Figure 6)

Figure 6 shows the age distribution of long-line samples from the spring fishery (April to June) in Finnmark in the years 1949 to 1955 and the mean of the periods 1934 to 1939 and 1949 to 1954.

These distributions are probably fairly representative of the population of immature cod (5-9 years old) in the south-eastern Barents Sea except for the year 1954. In this particular year the age distribution observed was very different from the one expected, and the total yield of the fishery (20,000

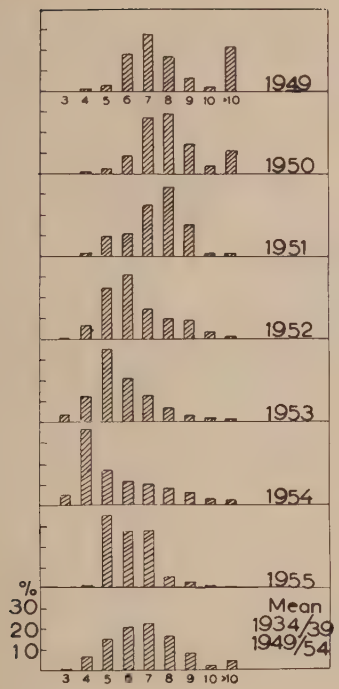

Figure 6. Age distribution of Finnmark "spring cod" taken on long-lines.

tons) was far below our predicted estimate. It is thought that the unusually high temperatures, prevailing in the Barents Sea in the winter and spring of 1954, adversely influenced the ordinary migrations to the Finnmark coast.

In 1955 the 1948 and 49 year-classes were represented by what is probably their true abundance and the yield increased to the post-war record of 47,000 tons.

The Stock of Skrei

(Figure 7)

The age composition of male and female fish is shown in Figure 7. Comparison with the period 1932 to 1951 shows an excess of young fish (1947 and 1948 broods).

In 1953 and 1954 the yield of the Lofoten fishery was unusually low, corresponding to the depleted stock. A slight rise in the yield per fisherman occurred in 1955 (total yield 46,364 tons). A prediction, mainly based on observations of the immature part of the stock, was given for the 1956 season, indicating an increase in the total yield to about 60—70,000 tons. This season actually yielded approximately 63,000 tons. In 1957 a

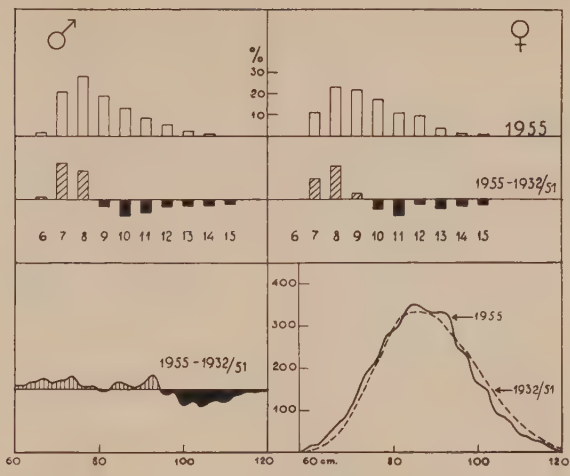

Figure 7. Age and length distribution of skrei, Lofoten.

further increase is expected following the maturing of the 1948 and 1949 year-classes.

G. Sætersdal

Baltic Stock

Polish Investigations

Fewer cod were caught in the vicinity of Gdansk in 1955 than in any of the last six years; the yield per hour's trawling was equal to that of former years only in January and February. The age composition of the stock on the whole was similar to that in previous years. Age-groups III (32.6% by weight) and IV (24.2% by weight) were the most numerously represented in the catches.

In 1955, however, the proportion of juvenile fish of the I and II age-groups, i. e., the 1954 and 1953 year-classes was the highest so far observed. The fish of these year-classes can be shown to have been relatively abundant, in spite of the fact that there were fewer adult fish (age-groups IV—VI) in the catches. The 1949 year-class (age-group VI) appeared in comparatively large numbers and this tends to confirm the view that the brood of that year was exceptionally good. The mean length and weight of the fish at different ages were as follows:—

Age-groups	I	II	III	IV	V	VI
Mean length, cm.	25.0	34.1	41.1	47.2	57.0	65.5
Mean weight, g.	160	375	715	1065	1625	2660

The mean length of all cod in the 1955 catches was 40 cm.

In Gdansk Deep spawning fish were first observed in March (9.5%); they were mostly males, which

were the first to assemble on the spawnings grounds, whereas females predominated in the later months. The percentage of spawning fish was highest in April and May (4% and 29%). Spawning lasted until August.

The mean length of the cod in the Bornholm neighbourhood amounted to 40.6 cm.; the mean length was highest in the spring catches, and lowest at the end of the year.

The cod began spawning in March, and spawning reached its greatest intensity in July (in April 20.7% were spawning fish, in July, 35.2%; and in August, 26.5%). Only a few spawning fish appeared in the October catches. The composition of the 1955 catches as regards maturity appeared as follows:—

53% of the fish — gonads in the juvenile and resting stages (I, II);
26% of the fish — gonads maturing (III, IV, V);
11% of the fish — gonads running (VI, VII);
10% of the fish — gonads spent (VIII).

ST. RUTKOWICZ

Table 12. Composition by Age and Length of Cod Stocks in the Northern Baltic in 1955

Age	I	II	III	IV	V	VI
%	0.5	22	42	26	9	0.5
Mean length, cm.	20.0	27.5	34.0	40.0	47.3	60.0

Table 13. Length Distribution of Spawning Cod in June 1955 (%)

cm.	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	Mean length
N. Baltic	1	15	25	28	15	10	5	1	—	34.5
Gdansk Deep	6	11	16	21	19	17	4	4	2	44.5

Table 14. Age Composition of Cod in Gotland Deep (%)

	II	III	IV	V	VI	VII	VIII	IX
1953	9.6	27.6	46.5	13.0	2.6	0.6	—	0.1
1954	2.2	16.1	45.6	20.4	8.6	5.2	1.8	0.1
1955[1]) ...	3.2	16.0	40.4	20.8	13.5	5.0	1.0	0.1

[1]) Complete data.

Russian Investigations in the Eastern Baltic

(Tables 12–15)

Between Ventspils and the Gulf of Finland, westward of Saaremaa and Hiiumaa, the bottom at depths of 24 to 182 m. in most cases appeared to be rough and trawling was possible only when guided by echo-sounder. The use of bobbins increases the catch two or three times and protects the trawl from damage.

In 1955 average catches in the spawning season in the area were not high (up to 200 kg. per 1-hour trawling). This indicates a scarcity of cod, for during the spawning season cod assemble in relatively dense shoals.

The small numbers of cod in 1955 may probably be accounted for by the poverty of the 1952 year-class, on which the commercial fishery mainly rested in 1955, as may be seen from Table 12.

The cod stocks in the northern parts of the Baltic consisted of smaller fish than in the southern, as may be seen in Table 13.

In the northern Baltic the cod spawn in deeper water than those in the south. The largest concentrations of spawning cod were found in water of depth between 142 and 182 m., and the largest numbers of eggs occurred with depths between 130 and 165 m.

Table 14 shows that in comparison with previous years, the stock of spawning cod in the south-eastern Baltic (Gothland Deep and adjacent areas) was characterized by two poor year-classes in the main commercial stock, namely, the 3-year-olds of the 1952 year-class and the 4-year-olds of the 1951 year-class.

This resulted in a somewhat smaller average catch of cod per hour's trawling at all seasons in 1955. In previous years (e. g., 1951—1953) the catch was observed to fall off mainly during the spawning season, which might be ascribed to the extension of the cod spawning grounds and the spreading of the spawning shoals over a wider area in response to the progressive increase of salinity in the deep waters of the Baltic.

The length distribution of the cod confirm the view that recruitment to the spawning stock in 1955 was poor. A rather large proportion of two-year-olds (1953 year-class) occurred in the catches on the feeding grounds off the eastern coasts in the second half of 1955.

G. TOKAREVA, A. PRIEDITIS

Table 15. Percentage Length Composition of the Cod in different Parts of the Eastern Baltic

cm.	15–20	20–25	25–30	30–35	35–40	40–45	45–50	50–55	55–60	60–65	65–70	70–75	75–80	–85
Gothland Deep[1])	1.2	3.0	4.1	13.1	24.3	18.4	11.5	6.7	5.7	4.9	4.1	1.8	0.9	0.3
Northern Baltic[2])	1.0	6.9	24.4	19.9	21.6	17.4	5.2	3.2	0.7	0.7	—	—	—	—
Ventspils[2])	0.9	9.0	20.7	25.6	19.5	9.7	6.2	3.1	2.4	1.9	0.8	0.2	—	—
Klaipeda-Pionersk[2]) ...	1.6	7.6	20.7	27.0	20.6	6.9	6.2	5.7	1.9	0.6	0.6	0.6	—	—

[1]) Spawning grounds, first half of 1955. [2]) Feeding grounds, second half of 1955.

HADDOCK

Icelandic Stock

Icelandic Investigations

(Figures 8-11; Tables 16-18)

1. Age distribution in recent years

To illustrate the state of the haddock stock in 1955, the age distributions of fish from Faxa Bay in 1948 and in 1951—1955 are presented in Figure 8. The samples were collected with a commercial trawl by the research vessel "María Júlía" in the southern part of Faxa Bay during the months May—June. The trawling localities are the two "traditional" stations, inside (64°04'N., 22°35'W.) and outside (64°08'N., 22°23'W.) the old 3-mile territorial limit. The 1951 sample, however, was taken near the Westman Islands.

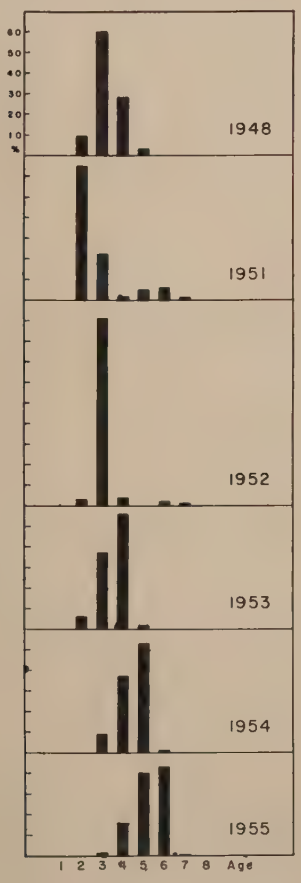

Figure 8. Age distribution of haddock in Faxa Bay 1948 and 1951—1955.

In 1951 the 1949 year-class largely dominated the samples taken off the south coast, and in 1952 this year-class completely dominated the samples from Faxa Bay, in which it comprised as much as 90% of the total. In 1953, however, the 1950 year-class appeared and amounted to about 37% of the total. These two year-classes together formed the major part of the stock of haddock during the next two years.

2. Age distribution, growth, and density around the coast in 1955

Figures illustrating the age distribution and average length of the age-groups, density of the stock in 1955, and other features are presented in Table 16. The age distribution is also shown graphically in Figure 9. The samples were collected with a commercial trawl by the research vessel "María Júlía" in July.

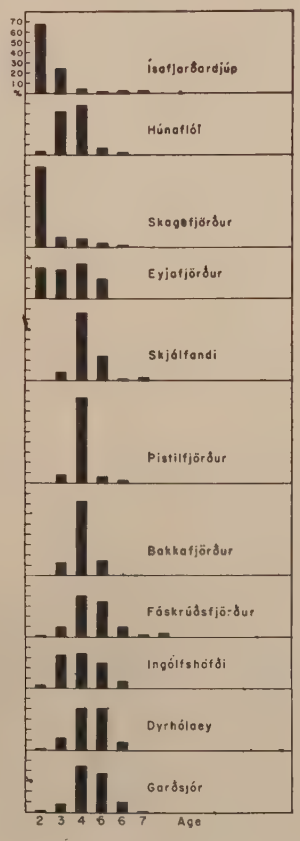

Figure 9. Age distribution of haddock at various localities.

Table 16. Age Distribution, Growth, Density of the Stock, etc., on the Coast of Iceland in 1955

Locality	Isafj. Deep	Húnafl.	Skagafj.	Eyjafj.	Skjálf.	Tistilsfj	Bakkaflói	Fáskrúdsfj.	Ingólfshöfdi	Dyrhólaey	Gardsjór
Position											
N.	66°16′	66°04′	66°04′	65°59′	66°00′	66°16′	66°04′	64°55′	63°49′	63°24′	64°06′
W.	23°20′	22°29′	19°45′	18°27′	17°30′	15°29′	14°45′	13°54′	16°30′	19°17′	22°32′
Date (July)	14	16	16	18	20	21	22	25	26	27	28
Depth, m.	120	30—50	115—140	55—75	15—60	55—75	35—90	101	25—60	39—50	34
Bottom											
°C.	6.7	7.6	5.9	7.1	7.7	5.1	4.8	4.0	7.7	—	9.9
m.	115	35	135	55	25	65	30	95	40	—	30
Av. length											
cm.	36.5	43.5	36.0	44.8	48.0	47.2	45.5	53.6	50.5	50.6	47.7
Catch per 1 hour (number)	25	205	69	424	471	151	1121	28	355	175	682
				Age distribution (‰)							
Age-groups											
II	673	9	785	298	—	—	10	18	33	6	3
III	224	524	92	277	83	85	121	91	322	116	75
IV	41	494	77	330	657	829	712	400	330	407	446
V	20	13	31	85	230	65	141	345	244	401	378
VI	—	4	—	11	10	20	5	91	63	70	95
VII	—	—	—	—	19	—	5	18	—	—	3
VIII	20	—	15	—	—	—	5	36	3	—	—
IX	—	—	—	—	—	—	—	—	3	—	—
XI	20	—	—	—	—	—	—	—	—	—	—
XII	—	—	—	—	—	—	—	—	3	—	—
				Average length, cm.							
II	32.1	31.5	31.7	34.3	—	—	31.5	33.0	33.2	36.0	32.0
III	39.5	40.8	39.2	44.4	43.7	44.1	38.8	32.0	41.2	40.2	38.0
IV	57.0	46.7	51.8	52.8	49.2	46.8	45.5	48.9	51.6	48.0	42.7
V	63.0	57.0	57.0	51.5	54.6	52.0	52.1	56.2	57.2	54.7	51.4
VI	—	55.0	—	60.0	55.0	50.8	54.0	66.6	64.6	68.8	57.8
VII	—	—	—	—	52.0	—	67.0	89.0	—	—	62.0
VIII	71.0	—	68.0	—	—	—	68.0	76.5	92.0	—	—
IX	—	—	—	—	—	—	—	—	89.0	—	—
XI	76.0	—	—	—	—	—	—	—	—	—	—
XII	—	—	—	—	—	—	—	—	88.0	—	—
Number invest.	49	231	65	94	204	199	198	55	394	172	294

In Ìsafjarðardjúp, on the west coast, and in Skagafjord on the north coast, the predominant year-class was that of 1953. This year-class was not numerous at the other stations. In the cold water area there is a well marked preponderance of the 1951 year-class, but in the warmer area, although the year-class is still abundant, its predominance is modified by the presence of both younger and older fish. In Faxa Bay the predominant year-classes are those of 1951 and 1950, and they present a somewhat different picture from that applicable to May (cf. Figure 8).

Table 16 also gives the number of fish per 1 hour's trawling. The largest numbers were taken in Bakkaflói (N.E. coast), but at this station only one haul of one hour was made and this may not be sufficiently representative. Apart from this, Faxa Bay yielded the highest catches with 682 haddock, per hour haul. The next best catches came from Skjálfandi Bay and Eyjafjord, with 471 and 424 fish respectively (central north coast). Ingólfshöfdi (central south coast) yielded 355 fish per hour trawl (see Table 16). The samples from all the localities mentioned above are reasonably representative and confirm the view that Faxa Bay is the region of greatest abundance of haddock in Icelandic waters.

In addition, Table 16 provides information on the growth of the haddock in various localities, and it is clear that the growth of this fish in the warm water differs from that in cold in a much more irregular fashion than in the case of cod. Fish of the 1952 year-class on the north coast grew more than those on the south coast, and according

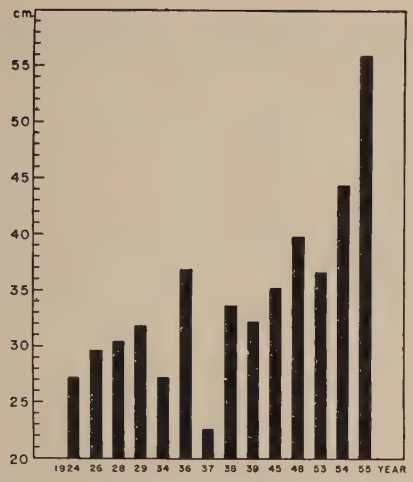

Figure 10. Average size of the Faxa Bay haddock from 1924 to 1955.

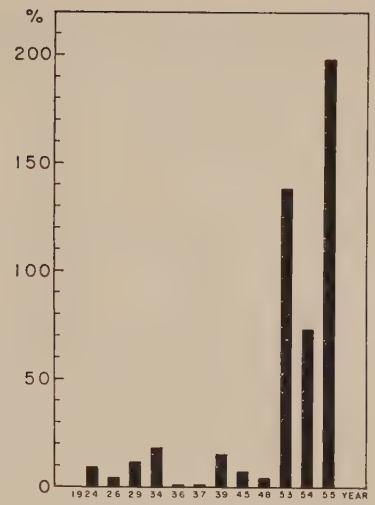

Figure 11. Density of haddock at the outermost station in Faxa Bay in relation (%) to the density at the innermost station.

to the results of pre-war investigations, growth is relatively slow in Faxa Bay. The growth of the cod in the same localities was also studied carefully in 1955 and the well known decrease in growth as we went clockwise round the coast from warmer to colder waters was clearly demonstrated. Obviously, the factors affecting the growth of haddock are not all the same as those affecting the growth of the cod.

3. Density of haddock in Faxa Bay

In May 1952 Faxa Bay was completely closed to trawling. Trawling experiments made at two selected stations in 1953 seemed clearly to indicate an increase in the stock of haddock (Friðriksson, Ann. Biol., Vol. X, 1953). These trawling experiments have been repeated four times each year and have shown a definite, positive response in the stock of haddock to the protective measures, as is illustrated by the following examples.

Figure 8 shows that the 1949 year-class was outstandingly numerous in 1951 and 1952, but in 1953 the 1950 year-class appeared in the catches and in that year comprised 37% of the stock. Since then these two year-classes have made up the greatest part of the catch. This state of affairs is not that usually found in heavily exploited stocks of haddock such as those in the North Sea, where for instance, haddock more than three years old are scarce.

The effect of protection is reflected by the increase in average size, as may be seen in Figure 10 which shows the average size of the haddock as found by the various trawling experiments. All these experiments were carried out in the period April-June on the so-called inner station, inside the old 3-mile territorial limit. It is clearly to be seen in the figure that the average size only once exceeded 35 cm. in pre-war years. Since 1953 there has been a steady increase in average size, which in May 1955 reached the highest recorded value of 55.9 cm.

In 1953 the average catch per hour haul was 949 haddock (territorial station).

By 1955 the number had dropped to 417, but the decrease in number is compensated by the increase in weight, as Table 17 clearly shows.

Table 17. Average Size, Number, and Weight of Haddock taken per Hour Haul in the Trawling Experiments in Faxa Bay

Period	Year	Average size, cm.	Weight kg.	Number per hour haul	Weight per hour haul
April–June	1924–48	31.4	0.33	257	85
All year	1953	41.5	0.85	949	807
All year	1954	51.3	1.62	644	1043
All year	1955	49.4	1.44	417	601

In 1955 the yield was 7.1 times the value of the 1924—1948 mean, although the yield was lower than that of the year before. This is due partly to a migration from the bay and partly to greater dispersal within the bay. The effect of dispersal is clearly shown by Figure 11, which indicates the difference in density between the inside and outside stations, the former territorial waters. In pre-war years the catch per unit effort outside the limit never exceeded 20% of the catch inside the limit, but the catch per unit effort in April-June during

Table 18. Results of the Haddock Marking Experiments in Faxa Bay during the Years 1953—1955

Year	1953	1954	1955
Number marked	326	1869	1330
Number recaptured (%)	4.29	3.16	0.38
Number recaptured outside Faxa Bay (%)	58.3	18.2	0.0

the period 1953—55, on the other hand, was 36% higher outside than inside the old territorial limit.

The main features of the migrations of the haddock in Faxa Bay are given in Table 18.

Three types of tags were used in these marking experiments (Scottish herring tags, Lea tags, and Alcathene tags). All were attached to the fish in front of the dorsal fin. These tagging experiments will be dealt with fully in a later publication.

In the 1953 experiments ca. 58% of the recaptured fish were taken outside Faxa Bay and ca. 86% of these were taken by other than Icelandic fishermen. Of these recaptures 70% were made during the period February—May. In the 1954 experiment all recaptures outside Faxa Bay were made during the period January—May. Thus it appears that the adult haddock leave the bay during the spawning season, and the location of the recaptures suggests that the migration is for spawning and is directed especially towards Selvogsbanki and the vicinity of the Westman Islands.

JÓN JÓNSSON

German Investigations

(Table 19)

The catch of haddock by German vessels in Icelandic waters is only small, for the modern German trawlers fish mostly in the deeper water. Formerly, before 1930, haddock made up between 10 and 20% of the total German catch in Icelandic waters. From 1930 the proportion fell rapidly to 6—3%, but after world-war II it rose again to 16% (1948), as a result of the fishing by older, smaller trawlers in shallow water and the large stock of haddock which was probably present after the war. Since 1950, however, the quantity of haddock caught has ranged between 5,100 and 6,400 tons (2.5—4.8% of the total catch).

In 1955, 5,961 tons (3.95%) of haddock were caught, of which 4,382 tons (73.5%) came from fishing grounds on the south-west coast, especially during the months of March, April, and May. The average length of the haddock on these grounds increased from 56.3 cm. to 58.8 cm. and 83.4% of the haddock caught consisted of fish of the 1949 and 1950 year-classes.

Table 19. Age and Length of the Haddock on the Fishing Grounds on the S.W. Coast of Iceland in March and April 1955 (‰)

Length cm.	‰	Length cm.	‰	Year-classes	‰
32—34	0	60—64	270	1952	7
35—39	11	65—69	148	1951	87
40—44	31	70—74	31	1950	367
45—49	74	75—79	9	1949	467
50—54	184	80—84	4	before 1949	72
55—59	236	>84	2		

ARNO MEYER

Arcto-Norwegian Stock

Norwegian Fishery

(Figures 12 and 13)

The main Norwegian fishery for arctic haddock is carried out in Finnmark. Figure 12 shows the age distribution of samples (immature fish) from the spring fishery of 1955 taken on long-lines and the corresponding mean for some previous years. The rich 1948 and 1950 year-classes have been predominant in the samples in this area since 1952. The record catches obtained in these years reveal the absolute strength of these year-classes. In 1953 and 1954 24,000 tons haddock were taken and in 1955, 27,000; in comparison, the annual mean catch was 11,000 tons in the period 1930—39 and 14,000 tons from 1948 to 1952.

From February to April the migrating mature part of the stock is found on the Norwegian coats

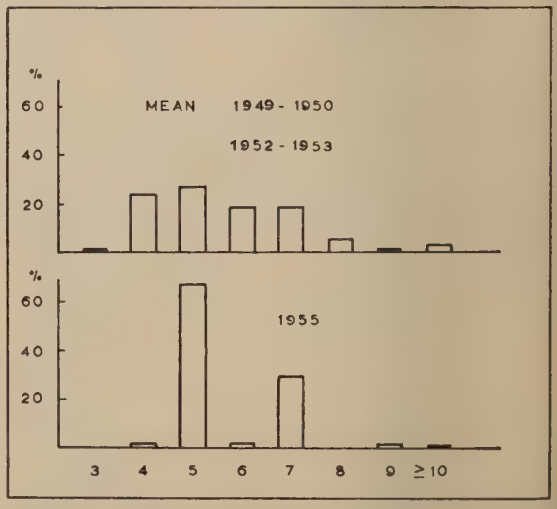

Figure 12. Age distribution of haddock from the Finnmark spring fishery taken on long-lines.

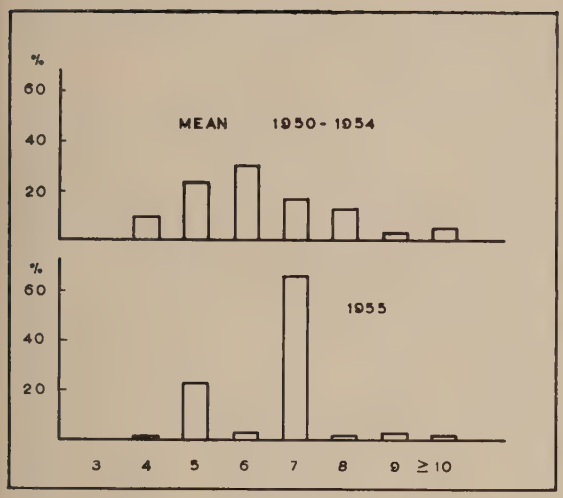

Figure. 13.
Age distribution of trawl-caught mature haddock.

from Røst to Malangen. Figure 13 shows the age distribution of trawl-caught samples from this area and reveal the predominance of the same two year-classes, those of 1948 and 1950.

G. Sætersdal

German Landings

(Table 20)

In 1955 catches of haddock by German vessels showed further increase over those of previous years. This is attributable mainly to the increase in numbers of the two rich year-classes of 1948 and 1950. The yield in 1955 was 15,475 tons (1954, 8,352 tons), that is, 16.8% of the total catch in the north-eastern area. With a catch of 12,513 tons (80.9%), more haddock than cod were taken in the Lofoten area. The average daily catch rose from 1.1 tons in 1953 to 2.3 tons in 1954 and 2.9 tons in 1955. On the spawning grounds there was a marked predominance of the 1948 year-class (average length, 59.9 cm.). The strong 1950 year-class appeared for the first time on the spawning grounds where well grown specimens of this class showed an average length of 53.5 cm. On the feeding grounds in the central region of the Barents Sea 90% of the haddock catch consisted of the 1950 year-class (average length, 47.0 cm.).

Arno Meyer

Table 20. Age and Length of Haddock landed by German Vessels from North-Eastern Fishing Grounds in 1955 (‰)

Length cm.	Norwegian coast Febr.—Apr.	Barents Sea Nov.—Jan.
36—39	0	15
40—44	7	290
45—49	48	449
50—54	149	178
55—59	366	32
60—64	295	19
65—69	97	8
70—74	21	3
75—79	10	3
80—84	6	2
85—89	1	1
90—94	0	0
Year-class		
1951	20	22
1950	159	898
1949	19	23
1948	734	48
before 1948	68	9

Faroe Stock

Scottish Investigations

(Tables 21 and 22)

Market sampling of the Faroe haddock stock was continued as in previous years and the data are given in Table 21.

Age composition

The age composition of haddock sampled from commercical trawlers is shown in Table 21A. The mean lengths of each brood are given in Table 21B and in Table 21C are shown the estimated weights of each brood landed per 10 hours' fishing each month. The latter were determined by converting the mean lengths in Table 21B to weights (using data from Russell 1914[1]) and then multiplying each by the appropriate number per 10 hours' fishing from Table 21A.

As in previous years, the younger broods (aged II—V) made up the greater part of the landings.

The commercial fishery

The average weights of haddock, per 100 hours' fishing, landed by Aberdeen trawlers from Faroe during 1955 are shown in Table 22 (see p. 149). The mean catch per 100 hours' fishing (167.3 cwts.) compares favourably with that of 143.8 cwts. in 1954, and continues the upward trend that started at 124.8 cwts. in 1952.

R. Jones, W. Main

[1]) Russell, E. S. (1914), Bd. Agric. and Fish. Inv., Ser. II, Sea Fish., 1, pt. 1.

Table 21. Aberdeen Trawlers' Market Samples - Faroe Haddock - 1955

A. Number landed/10 hrs. Fishing

Brood	Jan.	March	April	May	June	July	Aug.	Oct.	Nov.	Dec.[1])
1954	—	—	—	—	—	—	—	13.2	42.2	81.2
1953	354.3	35.2	10.1	359.6	1334.6	1438.2	1325.4	1941.9	1578.6	1724.9
1952	341.1	289.9	338.0	263.5	99.1	246.5	256.5	112.8	123.3	167.4
1951	94.1	146.9	482.4	183.7	55.7	107.7	83.0	62.1	41.7	33.3
1950	38.0	32.7	192.6	87.0	15.2	49.0	34.6	26.6	38.8	12.6
1949	1.0	25.1	69.8	78.3	10.6	37.3	19.6	22.7	13.9	4.7
1948	21.4	9.4	46.2	45.2	9.3	28.3	13.0	13.7	7.1	2.3
1947	2.4	4.5	17.5	6.0	4.1	13.3	10.2	5.0	3.3	2.8
1946	1.4	0.2	1.1	1.8	0.9	1.3	1.2	3.3	—	0.6
1945	6.9	4.9	10.8	7.8	5.7	15.7	9.1	2.6	5.1	0.4
1944	0.4	0.6	3.6	2.6	1.8	0.5	1.0	2.2	3.0	0.1
1943	—	0.9	3.4	1.7	0.7	0.3	0.2	0.3	—	—
1942+	—	0.2	1.1	—	—	—	—	—	—	—
Total	861.0	550.5	1176.6	1037.2	1537.7	1938.1	1753.8	2206.4	1857.0	2030.3

B. Mean Lengths of each Age-Group sampled

1954	—	—	—	—	—	—	—	33.00	32.42	32.35
1953	36.36	34.46	35.50	34.70	35.29	36.27	38.38	39.79	38.16	38.76
1952	42.08	42.63	40.86	41.75	45.59	44.87	47.35	48.49	49.24	47.46
1951	49.28	49.50	46.30	50.70	51.28	51.48	51.84	53.09	55.40	53.10
1950	55.17	55.59	54.02	55.64	56.82	57.40	57.67	59.28	59.63	58.10
1949	61.46	59.91	59.16	59.52	59.67	61.14	62.70	62.68	61.92	62.36
1948	63.24	63.64	62.14	62.71	64.68	63.75	65.28	66.00	64.27	65.52
1947	67.67	66.80	68.79	68.35	65.99	67.28	68.07	67.22	68.50	66.40
1946	66.50	70.00	65.00	66.50	70.33	67.33	69.50	70.50	—	72.00
1945	69.29	71.44	73.67	68.98	70.87	71.18	70.02	70.84	72.17	75.00
1944	75.00	73.00	71.83	73.00	72.90	72.50	67.50	74.83	73.78	73.33
1943	—	77.25	85.50	75.50	66.50	71.50	71.00	79.00	—	71.00
1942+	—	92.00	—	—	—	—	—	—	—	—

C. Estimated Weights[1]) landed/10 hrs. Fishing (in cwt.)[2])

1954	—	—	—	—	—	—	—	0.08	0.24	0.45
1953	2.80	0.23	0.07	2.37	9.59	11.35	12.50	20.91	14.92	16.71
1952	4.11	3.41	3.61	2.78	1.57	3.79	4.66	2.20	2.54	3.07
1951	1.91	2.67	7.45	3.78	1.25	2.48	2.00	1.62	1.26	0.88
1950	1.13	0.82	4.79	2.41	0.47	1.59	1.15	0.99	1.45	0.44
1949	0.04	0.83	2.44	2.70	0.38	1.49	0.83	0.96	0.58	0.20
1948	0.96	0.37	1.71	1.85	0.45	1.28	0.63	0.69	0.34	0.11
1947	0.12	0.19	0.86	0.30	0.20	0.67	0.57	0.26	0.18	0.13
1946	0.07	0.01	0.05	0.08	0.05	0.07	0.07	0.18	—	0.04
1945	0.35	0.27	0.64	0.38	0.35	0.90	0.52	0.15	0.30	0.02
1944	0.02	0.04	0.22	0.15	0.11	0.03	0.05	0.14	0.19	0.01
1943	—	0.62	0.24	0.09	0.03	0.02	0.01	0.02	—	0.01
1942+	—	0.01	0.08	—	—	—	—	—	—	—
Total	11.51	9.47	22.16	16.89	14.45	23.67	22.99	28.20	22.00	22.07
Actual landings per 10 hrs. by Aberdeen trawlers	11.30	9.53	21.49	16.17	13.45	21.28	20.80	25.05	20.73	21.43

[1]) Estimated using data from RUSSELL, 1914.

[2]) No samples taken in February and September, but actual landings per 10 hrs. fishing were 8.44 and 17.77 cwt. for the two months respectively.

Table 22. Landings of Three Size Categories by Aberdeen Trawlers from Faroe - 1955

(cwts. per 100 hours)

Month	Hours fishing	Extra large and large	Medium	Small	Total
January	3420	39.8	44.6	28.6	113.0
February ...	6187	25.8	31.5	27.1	84.4
March	8010	43.4	36.2	15.7	95.3
April	7707	109.2	70.8	34.9	214.9
May	5304	65.5	44.5	51.7	161.7
June	14166	27.0	29.1	78.4	134.5
July	9299	62.8	39.8	110.2	212.8
August	7494	58.9	42.9	106.2	208.0
September ..	1664	47.4	27.6	102.7	177.7
October	1907	48.4	66.5	135.6	250.5
November...	7740	39.0	66.7	101.6	207.3
December ..	4161	44.4	73.5	96.4	214.3
Total/Mean..	77059	50.6	45.6	71.1	167.3

Table 24. Distribution and Density of the 1955 Brood in "Explorer" Catches

	June to December 1955		
	Number of fish	Number of hours	Per 10 hours
Northern	923	$7^1/_2$	1231
North Central	497	11	452
Central	1392	$17^1/_2$	795
Moray Firth and Orkney	Nil	1	Nil
Firth of Forth	425	15	283
West	—	—	—
Total for all areas	3237	52	622

North Sea Stock

Scottish Investigations

(Tables 23-25)

The haddock population of the northern North Sea was sampled extensively by F.R.S. "Explorer". In particular, cruises during March, June/July, July/August, and September/October were each designed to give representative sampling of the north, north central, and central regions.

The age composition of the haddock sampled by "Explorer" is given in Table 23. Catches consisted predominantly of the 1953 and 1954 year-classes which were widely distributed. As in previous years, the two-year and older fish were most abundant in the northern area. The one-year-old fish were fairly uniformly distributed in 1955 instead of being most abundant in the central region as in previous years.

The 1955 year-class (Table 24) was well represented in the catches and appears to be a good year-class.

Size composition

The mean sizes of the haddock broods sampled are given in Table 25 (see next page). The smallest fish, age for age, were found in the north and north central regions. Central North Sea haddock were larger, while the largest fish came from the Moray Firth and Orkney region.

R. Jones

Table 23. Age Composition of Haddock caught by F.R.S. "Explorer" in 1955 per 10 Hours Trawling

Month	Northern Area Jan./Mar.	Apr./June	July/Sept.	Oct./Dec.	All Months	North Central Jan./Mar.	Apr./June	July/Sept.	Oct./Dec.	All Months	Central Jan./Mar.	Apr./June	July/Sept.	Oct./Dec.	All Months
Hrs. trawling	1	—	$4^1/_2$	3	$8^1/_2$	$2^1/_2$	$1^1/_2$	$7^1/_2$	2	$13^1/_2$	78	56	$10^1/_2$	4	$148^1/_2$
Year-class					Weighted means					Weighted means					Weighted means
1954	710	—	1756	1100	1401	1708	167	1731	2225	1626	132	3319	3044	882	1560
1953	1250	—	1053	760	973	620	40	899	480	690	556	675	549	78	587
1952	690	—	689	997	798	356	53	328	90	267	288	144	164	12	218
1951	130	—	202	390	260	60	7	76	10	56	23	15	17	—	19
1950 and over	20	—	38	127	67	16	—	4	—	5	2	3	10	—	3
	Moray Firth and Orkney					Firth of Forth					West				
Hrs. trawling	—	—	—	1	—	$15^1/_2$	6	6	9	$36^1/_2$					
Year-class	—	—	—	—	—	—	—	—	—	—					
1954	—	—	—	50	—	7	—	—	181	48					
1953	—	—	—	190	—	32	—	—	2	14					
1952	—	—	—	180	—	68	—	—	—	29	Not visited				
1951	—	—	—	10	—	29	—	—	—	12					
1950 and over	—	—	—	—	—	3	—	—	—	1					

Table 25. Mean Lengths (cm.) and Standard Errors of Haddock of each Age-Group from the North Sea 1955

Year-class	Age	Month	Northern Mean	Northern S.E.	Northern No. of Fish	North Central Mean	North Central S.E.	North Central No. of Fish	Central Mean	Central S.E.	Central No. of Fish	Moray Firth and Orkney Mean	Moray Firth and Orkney S.E.	Moray Firth and Orkney No. of Fish	Firth of Forth Mean	Firth of Forth S.E.	Firth of Forth No. of Fish
1955 ...	0+	June	—	—	*	5.2	0.214	16	—	—	Nil	—	—	*	—	—	*
		July-Sept.	11.2	0.490	15	12.8	0.191	177	13.1	0.136	511	—	—	*	11.3	0.186	14
		Oct.-Dec.	15.2	0.056	908	15.5	0.079	304	17.5	0.054	881	—	—	Nil	16.4	0.079	411
1954 ...	1+	Jan.-Mar.	17.2	0.153	71	17.8	0.062	427	18.1	0.047	1026	—	—	*	18.5	0.434	11
		Apr.-June	—	—	*	20.8	0.258	25	17.7	0.010	18589	—	—	*	—	—	Nil
		July-Sept.	22.9	0.076	790	24.6	0.054	1298	24.9	0.028	3196	—	—	*	—	—	Nil
		Oct.-Dec.	24.1	0.079	330	27.1	0.088	445	27.2	0.084	353	29.2	1.020	5	27.4	0.143	163
1953 ...	2+	Jan.-Mar.	25.8	0.140	125	26.6	0.200	155	26.4	0.033	4335	—	—	*	28.5	0.936	50
		Apr.-June	—	—	*	28.7	0.714	6	26.5	0.092	3779	—	—	*	—	—	Nil
		July-Sept.	28.7	0.108	474	29.8	0.081	674	31.9	0.101	576	—	—	*	—	—	Nil
		Oct.-Dec.	28.1	0.168	228	32.1	0.319	96	32.6	0.419	31	36.4	1.027	19	35.5	0.500	2
1952 ...	3+	Jan.-Mar.	30.6	0.171	69	31.6	0.384	89	33.6	0.069	2250	—	—	*	35.5	0.289	105
		Apr.-June	—	—	*	36.1	1.564	8	33.8	0.108	804	—	—	*	—	—	Nil
		July-Sept.	32.9	0.132	310	34.1	0.156	246	37.8	0.252	172	—	—	*	—	—	Nil
		Oct.-Dec.	33.5	0.145	299	35.7	0.779	18	38.4	2.135	5	42.9	0.751	18	—	—	Nil
1951 ...	4+	Jan.-Mar.	34.7	0.430	13	37.8	0.712	15	41.6	0.207	180	—	—	*	41.1	0.640	45
		Apr.-June	—	—	*	41.0	—	1	41.0	0.399	84	—	—	*	—	—	Nil
		July-Sept.	36.9	0.292	91	36.8	0.321	57	44.0	0.918	18	—	—	*	—	—	Nil
		Oct.-Dec.	36.6	0.247	117	36.5	1.500	2	—	—	Nil	54.0	—	1	—	—	Nil
1950 and older	5+ and older	Jan.-Mar.	44.0	10.000	2	52.5	2.598	4	48.4	1.153	19	—	—	*	53.4	2.542	5
		Apr.-June	—	—	*	—	—	Nil	48.4	1.911	15	—	—	*	—	—	Nil
		July-Sept.	41.2	1.346	17	42.0	2.887	3	51.5	1.586	10	—	—	*	—	—	Nil
		Oct.-Dec.	41.0	0.830	38	—	—	Nil	—	—	Nil	—	—	Nil	—	—	Nil

* Not visited.

German Investigations

(Figure 14; Tables 26-29)

Although the main purpose of the cruise of the R/V "Anton Dohrn" from 28. July to 25. August 1955 in the North Sea was herring investigations, data on the composition of the haddock population were also collected. The lengths of 4319 fish were measured and 2360 age determinations were made. As may be seen in Figure 14 trawl hauls were carried out in several places in the North Sea. As a whole, sampling was effected by means of the ordinary herring trawl (180 feet), the hauls were mostly of half an hour's duration.

Age composition and mean length

The age composition of the haddock population in different regions in August 1955 is shown in Table 26. The mean catch per 10 hours trawling was

Table 26. Mean Catch per 10 Hours Trawling (Number of Fish) and Age Composition (%) of Haddock caught by the "Anton Dohrn" in the North Sea in August 1955

Age-group	Year-class	Jutland Bank Little Fisher Bank	German Bight Dogger Bank	Egersund-Klondyke	Ling Bank	Central Area N. of 57°30′N.	Central Area S. of 57°30′N.
0	1955	550 (52)	— (—)	7 (1)	490 (8)	2 (0.1)	— (—)
I	1954	115 (13)	180 (32)	404 (83)	510 (19)	1105 (46)	857 (66)
II	1953	160 (23)	217 (40)	67 (14)	1190 (29)	923 (34)	530 (27)
III	1952	60 (11)	166 (23)	12 (2)	1590 (34)	501 (17)	176 (5.5)
IV	1951	5 (1)	35 (4)	—	320 (8)	93 (3)	20 (1)
V	1950	—	2 (1)	—	60 (1)	6 (0.2)	4 (0.5)
VI	1949	—	—	—	40 (1)	1 (0.03)	—
All ages		890 (100)	600 (100)	490 (100)	4200 (100)	2631 (100)	1587 (100)
Trawl stations ..		4	11	3	2	18	5

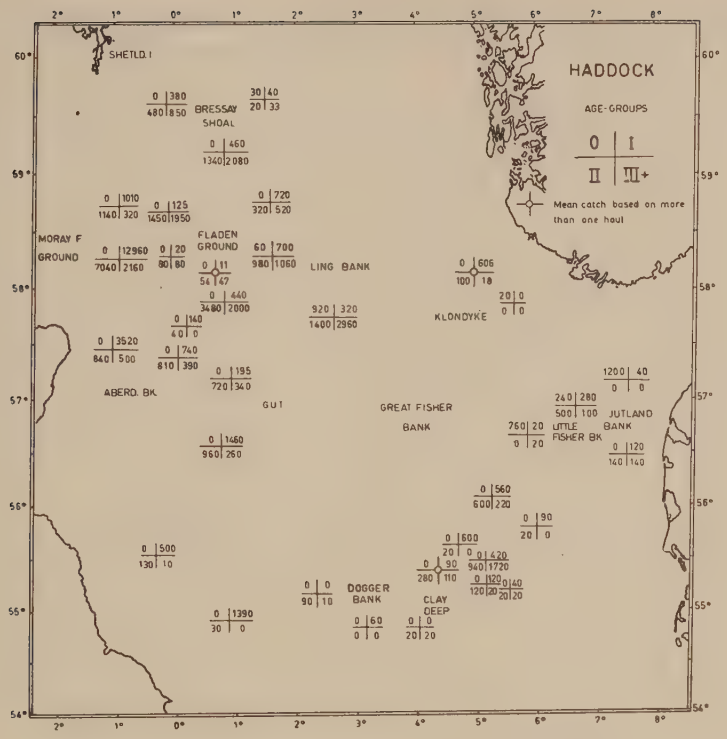

Figure 14. Catch of haddock per 10 hours trawling by the R/V "Anton Dohrn" in August 1955.

reckoned only from figures relating to the hauls shown in Figure 14, because on the other few hauls different gear was used. For the percentage figures for the age composition, however, figures from all stations were used. The 1952, 1953, and 1954 year-classes were well represented in all areas, as was also the numerous 1951 brood, especially in the Ling Bank area. Little can be said about the distribution and density of the 1955 brood, since in August only a few of the small haddocks have reached the bottom stage, and cannot be caught in representative numbers. The catch of 1200 of these fish per 10 hours trawling in the Jutland Bank area, however, is very remarkable (Fig. 14).

In Table 27 the mean lengths of the haddock from various parts of the North Sea are compared.

Table 27. Mean Lengths (cm.) of Haddock caught by the R/V "Anton Dohrn" in the North Sea in August 1955

		Jutland Bank Little Fisher Bank			German Bight Dogger Bank			Egersund-Klondyke			Ling Bank			Central Area N. of 57°30′N.			Central Area S. of 57°30′N.		
Age-group	Year-class	Mean	Range	No. of fish	Mean	Range	No. of fish	Mean	Range	No. of fish	Mean	Range	No. of fish	Mean	Range	No. of fish	Mean	Range	No. of fish
0	1955	9.8	7–12	110	—	—	—	(10.0)	—	1	8.5	7–12	26	(11.0)	9–12	3	—	—	—
I	1954	25.7	23–30	27	24.5	20–28	95	22.7	18–27	147	22.3	19–26	61	24.1	20–28	110	24.1	20–30	400
II	1953	32.7	28–36	50	31.7	26–41	118	27.6	21–36	25	31.1	25–39	92	29.5	23–35	327	30.5	24–38	157
III	1952	37.4	31–47	24	36.0	29–42	67	(34.3)	33–35	3	35.5	28–49	110	33.9	28–42	301	35.6	29–41	51
IV	1951	(44.0)	—	1	39.6	36–44	11	—	—	—	39.0	33–48	25	36.7	33–41	61	37.8	31–42	11
V	1950	—	—	—	(46.0)	—	1	—	—	—	(46.0)	42–50	3	37.5	35–43	6	42.2	39–47	5
VI	1949	—	—	—	—	—	—	—	—	—	(53.0)	50–56	2	(52.0)	35–71	3	—	—	—

Table 28. Landings of Haddock and Mean Catch per Day's Fishing (bracketed figures) by German Trawlers in the North Sea 1945—1955 (in metric tons)

Month	1945		1946		1947		1948	
	Demersal trawling	Herring trawling	Demersal trawling	Herring trawling	Demersal trawling	Herring trawling	Demersal trawling	Herring trawling
January	—	—	2699 (2.8)	—	125 (0.6)	—	526 (0.6)	—
February	—	—	1248 (1.2)	—	58 (0.2)	—	100 (0.1)	—
March	—	—	405 (0.3)	—	8 (0.1)	—	115 (0.1)	—
April	—	—	373 (0.4)	—	34 (0.1)	—	154 (0.3)	—
May	—	—	577 (0.8)	—	59 (0.1)	—	227 (0.5)	—
June	—	—	363 (0.8)	—	28 (0)	—	192 (0.5)	—
July	102 (0.4)	—	197 (0.5)	85 (0.6)	45 (0.1)	6 (0)	26 (0.1)	7 (0)
August	724 (0.9)	16 (0.2)	93 (2.7)	39 (0)	4 (0.2)	2 (0)	1 (0)	16 (0)
September	338 (1.7)	33 (0.1)	29 (2.9)	25 (0)	41 (2.3)	51 (0)	—	14 (0)
October	—	297 (0.3)	103 (1.5)	75 (0)	13 (0.7)	124 (0.1)	—	34 (0)
November	714 (3.5)	750 (0.9)	655 (1.1)	774 (0.8)	80 (0.8)	219 (0.1)	128 (1.6)	170 (0.1)
December	2483 (2.1)	—	1581 (1.5)	5 (0.1)	1916 (2.0)	—	294 (0.4)	44 (0.3)
Year	4361 (1.6)	1096 (0.5)	8323 (1.1)	1003 (0.2)	2411 (0.6)	402 (0)	1763 (0.3)	285 (0)

Month	1949		1950	1951		1952	
	Demersal trawling	Herring trawling	Demersal + Herring trawling	Demersal trawling	Herring trawling	Demersal trawling	Herring trawling
January	114 (0.2)	—	17 (0.1)	20 (0.1)	—	5 (0.1)	—
February	118 (0.2)	—	11 (0)	7 (0)	1 (0)	14 (0.1)	1 (0)
March	56 (0.1)	—	10 (0)	40 (0.2)	—	67 (0.4)	48 (0.1)
April	59 (0.1)	—	13 (0)	4 (0)	1 (0)	12 (0)	—
May	23 (0.1)	—	31 (0.1)	21 (0.1)	—	34 (0.1)	—
June	15 (0.1)	—	57 (0.1)	53 (0.2)	3 (0)	23 (0.2)	—
July	10 (0)	2 (0)	31 (0.1)	22 (0.1)	13 (0)	2 (0)	5 (0)
August	—	27 (0)	26 (0)	—	119 (0)	—	70 (0)
September	—	49 (0)	117 (0)	—	126 (0)	—	124 (0)
October	—	34 (0)	40 (0)	—	45 (0)	-	19 (0)
November	0 (0.1)	72 (0)	67 (0)	2 (0.1)	60 (0)	—	0 (0)
December	26 (0.1)	15 (0)	25 (0)	2 (0.1)	3 (0)	4 (0.1)	—
Year	421 (0.1)	199 (0)	445 (0)	171 (0.1)	371 (0)	161 (0.2)	267 (0)

Month	1953		1954		1955	
	Demersal trawling	Herring trawling	Demersal trawling	Herring trawling	Demersal trawling	Herring trawling
January	43 (0.2)	—	19 (0.2)	—	1 (0)	—
February	26 (0.1)	3 (0)	17 (0.1)	1 (0)	18 (0.1)	1 (0)
March	152 (0.5)	19 (0.1)	89 (0.3)	2 (0)	101 (0.4)	10 (0.1)
April	13 (0.1)	0 (0)	9 (0.1)	7 (0)	4 (0.1)	16 (0.1)
May	10 (0.1)	—	4 (0.1)	6 (0)	6 (0.1)	4 (0)
June	13 (0.4)	—	16 (0.1)	2 (0.2)	102 (2.6)	69 (0.8)
July	—	5 (0)	—	41 (0)	—	464 (0.3)
August	—	55 (0)	—	143 (0.1)	—	342 (0.1)
September	—	96 (0)	—	226 (0.1)	—	188 (0.1)
October	—	31 (0)	—	198 (0.1)	—	169 (0.1)
November	—	5 (0)	—	22 (0.1)	—	17 (0)
December	—	—	—	—	59 (1.2)	5 (1.0)
Year	257 (0.3)	214 (0)	154 (0.2)	648 (0.1)	291 (0.5)	1285 (0.1)

(0) = Mean catch per day's fishing 0–0.05 tons.

Commercial landings

The quantities of haddock from the North Sea landed by German trawlers at German ports in post-war years are shown in Tables 28 and 29; the figures show the decline in the catches since 1946. The heavy landings in 1945/46 are in part due to the fact that the German trawlers worked mainly in the North Sea at that time, and very little in far northern waters. From 1945 to 1950 the mean catch per day's fishing became steadily lower, but

Table 29. Landings of Haddock and Mean Catch per Day's Fishing (bracketed figures) by German Trawlers for various Regions of the North Sea in 1946, 1949, and 1955 (in metric tons)

(Only catches with the bottom trawl are included; e. g., haddock caught in the herring fishery are not included)

Month	Year	Viking Bank	Utsire Ground	Ling Bank	Fladen Ground
	1946	—	—	—	2043 (2.9)
Jan.	1949	53 (0.3)	9 (0.1)	42 (0.2)	—
	1955	1 (0.1)	0 (0)	—	—
	1946	141 (0.5)	—	—	689 (1.5)
Febr.	1949	53 (0.1)	65 (0.5)	—	—
	1955	6 (0.1)	2 (0)	—	—
	1946	149 (0.1)	—	—	98 (1.3)
March	1949	33 (0.1)	2 (0.2)	—	—
	1955	10 (0.1)	—	—	—
	1946	98 (0.1)	46 (0.3)	26 (2.3)	—
April	1949	1 (0)	2 (0.1)	—	1 (0.1)
	1955	2 (0.1)	—	—	—
	1946	254 (0.8)	2 (0)	72 (1.4)	34 (1.2)
May	1949	7 (0.1)	—	—	1 (0)
	1955	1 (0.1)	—	—	—
	1946	144 (1.2)	30 (0.2)	79 (2.1)	22 (2.4)
June	1949	2 (0)	—	—	—
	1955	94 (3.0)	—	—	—
	1946	36 (0.6)	50 (0.4)	13 (1.2)	12 (0.7)
July	1949	—	—	—	—
	1955	—	—	—	—
	1946	50 (2.1)	—	—	—
Aug.	1949	—	—	—	—
	1955	—	—	—	—
	1946	—	—	—	—
Sept.	1949	—	—	—	—
	1955	—	—	—	—
	1946	—	—	—	1 (0.2)
Oct.	1949	—	—	—	—
	1955	—	—	—	—
	1946	88 (0.8)	2 (0.2)	71 (3.0)	32 (0.7)
Nov.	1949	0 (0.1)	—	—	—
	1955	—	—	—	—
	1946	99 (0.6)	—	724 (2.1)	292 (1.4)
Dec.	1949	7 (0.1)	19 (0.1)	—	—
	1955	20 (1.0)	—	—	14 (1.2)
	1946	1059 (0.4)	130 (0.3)	985 (2.0)	3223 (2.1)
Year	1949	156 (0.1)	97 (0.2)	42 (0.2)	2 (0.1)
	1955	134 (0.4)	2 (0)	—	14 (1.2)

	Shetland Islands	Gut	Dogger Bank	Great Fisher Bank	Jutland Bank
1946	5 (0.6)	413 (1.9)	97 (1.7)	586 (1.8)	51 (1.2)

(0) = Mean catch per day's fishing 0–0.05 tons.

was followed by a fresh rise in 1955. A change in the structure of the German North Sea trawl fishery generally, can be stated. Bottom trawling for herring became more and more widely practised. In 1955 the quantity of haddock landed from the herring trawlers amounted to more than four times that landed by demersal trawlers.

D. Sahrhage

SAITHE

Icelandic Stock

German Landings

(Tables 30-32)

Since they reached a peak in 1951/52, the landings of saithe by German vessels from Icelandic waters have gradually declined as is shown in Table 30.

Table 30. Landings of Saithe from Iceland Waters by German Vessels (in 1000 kg.)

	1950	1951	1952	1953	1954	1955
Size-category I (large)	22,825	24,680	22,632	16,019	12,586	7,362[1])
Size-category II + III (medium and small)	7,010	8,759	12,692	7,422	11,834	8,982
Total	29,835	33,439	35,324	23,441	24,420	16,344

[1]) preliminary figures.

While there are large variations in the quantities of medium- and small-size saithe (categories II and III) we may notice that for the large, old saithe of size-category I a remarkably steady decrease has occurred since 1952. The yield in 1955 was only about one-third of the yield in 1951, the best year, and as a result, the German saithe industry, an important part of the whole German fishing industry, has fallen into serious trouble due to the lack of large saithe in the last two years. The German saithe industry has an annual consumption of about 15,000 tons of fish and depends mainly on the large fish (category I) from Icelandic waters.

From investigations made on board trawlers in different seasons, market measurements, and the "Anton Dohrn's" surveys since 1955, we have obtained sufficient information on the biology of the saithe stock to enable us to understand the course of the German commercial fishery for saithe. Let

Table 31. Length and Age Composition of the Spawning Stock of Saithe in 1955

cm.	1953	1954	1955	Year-classes	1953	1954	1955
46— 50	+	+	+	1950	—	—	19
51— 55	1	3	7	1949	—	16	102
56— 60	1	11	20	1948	2	96	231
61— 65	1	25	56	1947	22	96	75
66— 70	10	54	44	1946	131	196	82
71— 75	42	50	82	1945	150	84	81
76— 80	98	79	110	1944	249	158	62
81— 85	188	122	79	1943	85	38	26
86— 90	180	147	76	1942	25	16	20
91— 95	130	143	98	1941	26	20	36
96—100	95	105	116	1940	38	21	24
101—105	134	101	123	1939	69	68	88
106—110	80	107	130	1938	20	17	15
111—115	39	43	50	1937	40	44	60
116—120	1	9	9	1936	36	14	14
121—125	—	1	+	1935	39	58	48
				1934	32	19	5
				1933	19	19	7
				1932	10	9	3
				1931	4	7	2
				1930	2	4	—
				1929	1	—	—

us first consider the biological condition of the spawning stock concentrated off the south and south-west coasts of Iceland from about January to April.

Table 31 shows the main characteristics of the stock of spawning saithe in 1953, 1954 and 1955. The figures for 1955 are based on the age determinations of 4330 saithe caught on German trawlers during the months of January to April.

We may notice that in general some remarkable additions to the spawning stock have been made since 1953 and 1954. In those years the 1948 and 1949 year-classes were by far the most numerous and all others were relatively insignificant. The strong 1939, 1937, and 1935 year-classes were present in fairly large quantities and made up about the same proportion of the stock as the 1944, 1945, and 1946 year-classes.

Table 32. Saithe Landings in 1000 kg. and Mean Catch per Day's Fishing off the South and South-West Coast of Iceland during the main Spawning Period in 1955

	Saithe landings January to April 1,000 kg.	Mean catch per day's fishing (March) kg.	No. of fish
1946	3,007	6,600	1,299
1947	8,957	5,900	1,220
1948	3,898	5,900	1,251
1949	12,983	7,700	1,513
1950	14,985	7,600	1,485
1951	19,205	7,100	1,553
1952	16,514	5,200	1,168
1953	6,536	5,200	1,028
1954	4,054	4,700	915
1955	3,396	3,950	770

The mean catch per day's fishing, the measure of population density, and the total stock have steadily diminished in recent years, as may be seen in Table 32.

The low level of the yield from 1946 to 1948 is the result of the economic crisis prevailing immediately after the war. With the development of the deep-sea trawler fleet the saithe catches increased rapidly until they reached a peak in 1951. Since that time they have decreased and in 1953 the decline was very sharp.

As regards the age composition, it is well known that in the last ten years there have been three occasions on which recruitment to the stock has been sufficient to influence the yield of the fisheries. The rich 1939 year-class, together with those of 1937 and 1935, which were nearly as rich, produced an unusually plentiful stock which was maintained until 1950. Then, in 1951, a new wave of recruitment took place, in the form of the 1944, 1945, and 1946 year-classes. The 1945 year-class gave a very fair promise for the future but failed to redeem it. The mean catch per day's fishing gradually fell off because these year-classes had not the strength of the old 1939—35 classes. As the effect of this second wave ran out, the yield from the spawning grounds in 1954/55 declined to an extent unknown previously. Even the third wave of recruitment coming in 1955 — the 1948–49 year-classes — could not prevent a fall in the mean catch per day's fishing resulting from the disappearance of the older fish and the lack of a good year-class of young fish to replace them.

The decrease in the density and abundance of the spawning stock is not so critical, however, as to account entirely for the sharp decline in the landings. The principal reason is much more likely to be the change-over from saithe to redfish fishing. The more profitable redfish became, the more saithe were neglected. In the first four months of 1950 the fishery yielded only half as many redfish as saithe, but by 1953 the landings of redfish were nearly seven times those of saithe. The total redfish landings from Icelandic waters rose from 63,000 tons in 1950 to more than 146,000 tons in 1955 and they will grow even more in future as a result of the discovery of the Anton Dohrn Bank. The decline in saithe landings is therefore attributable firstly to economic conditions and only secondly to changes within the stock itself.

Ulrich Schmidt

Norwegian Stock

German Investigations

(Table 33)

Further surveys of the saithe population were made by the R/V "Anton Dohrn" during November/December 1955 off the north-west and north coasts of Norway. Particular attention was given to the relation of sexual maturity to age. The market investigations were continued.

Length and age of the fish landed

Table 33 shows for each year from 1951 to 1955 the length and age distribution of the spawning saithe caugth by German vessels at Svinøy on the Norwegian coast in February/March, together with the length and age composition of the catches off the Lofoten banks between September 1954 and March 1955.

Table 33. Length and Age of the Spawning Saithe, 1951 to 1955, and off the Lofoten Banks between September 1954 and March 1955

	Spawning stock at Svinøy					Lofoten banks
cm.	1951	1952	1953	1954	1955	1954/55
42— 45					—	—
46— 50	—	—	—	—	+	1
51— 55	—	+	—	—	1	23
56— 60	6	5	7	+	7	113
61— 65	21	22	21	26	31	267
66— 70	112	78	118	111	87	211
71— 75	256	206	249	182	164	138
76— 80	174	296	187	224	227	86
81— 85	170	142	135	122	188	62
86— 90	88	83	106	97	128	35
91— 95	85	71	72	95	76	23
96—100	53	53	55	77	53	22
101—105	20	30	39	42	25	11
106—110	13	10	9	18	12	7
111—115	2	3	2	5	1	1
116—120	—	1	—	1	—	+
Mean catch/ day's fishing kg.	19,224	27,609	19,470	10,249	13,989	—
Year-class						
1950	—	—	—	—	3	25
1949	—	—	—	+	97	484
1948	—	—	5	129	242	189
1947	—	4	57	215	197	95
1946	2	15	346	290	181	65
1945	26	136	136	70	55	20
1944	187	402	95	46	68	23
1943	274	212	108	68	37	16
1942	112	63	51	33	31	18
1941	75	32	39	30	24	16
1940	105	33	42	38	30	11
1939	56	30	34	28	16	13
1938	55	15	28	20	2	5
1937 and older	108	58	59	33	17	20

In the catches of spawning saithe at Svinøy in 1955, the 1948 year-class predominated; this year-class, together with those of 1947 and 1946, were sufficiently numerous to produce a further small increase in the density of the spawning stock, from which the rich 1943 and 1944 year-classes, predominant in 1951 and 1952, had disappeared. The 1949 year-class, only a few of which had become mature, was relatively well represented. On the Lofoten banks, however, in the autumn of 1954 and spring of 1955, fish of the 1949 year-class, then mostly immature, were unusually numerous. Nearly half the total catch by the German trawlers belonged to this one year-class which is the first really strong class since those of 1943 and 1944. It gave rise to a second maximum in the German fishery off the Lofoten banks in March and April 1955.

Accordingly it was expected that this year-class would provide a good fishery in the 1955/56 season, when most of the fish in it would become mature. The failure of the fishery at the beginning of the season is therefore surprising. The age and length distributions of the catches were completely in accord with expectation; the 1949 year-class was the most numerous, and the proportion of fish of the promising 1950 year-class was relatively high too, but quite surprisingly catches were small.

The cruises of the R/V "Anton Dohrn" in northern Norwegian waters in November/December 1955 indicated, firstly, that the fish had not formed very dense shoals probably as a result of isothermal conditions in the water, and, secondly, that the spawning migration which normally starts in October/November, was delayed by the hydrographical conditions prevailing in the summer of 1955. Consequently, the peak of the fishery was not reached until the middle of December.

On the whole, the catch of saithe by German trawlers off the Norwegian coast rose from 13.9 mill. kg. in 1954 to 22 mill. kg. in 1955. This may be attributed to an increase in the stock, resulting from the arrival of the 1948 and 1949 year-classes, and to an increase in fishing intensity; the trawlers made 339 trips, against 258 trips in 1954.

Ulrich Schmidt

WHITING

North Sea Stock

German Observations

(Tables 34 and 35)

The investigations on the whiting stock, started in 1954 (see Ann. Biol., XI, pp. 105—6), were continued on two cruises of the R/V "Anton Dohrn" in March and August 1955.

The otoliths of 4484 fish were examined, and the percentage age distributions for the regions from which the samples were taken are given in Table 34. All hauls were made with the herring trawl.

The 1954 brood (age-group I) was strongly represented in the catches, except in those in the north-western region, and may be regarded as a "rich" year-class. The 1953 brood (age-group II), to the contrary, seems to be "poor". Among marketable fish age-groups III and IV predominated in all regions.

Table 35 shows the average lengths of the age-groups in cm. The differences in growth of whiting in the three areas are remarkable, and have yet to be studied in detail.

Table 34. Age Composition of Whiting

Region	S. of 57°N., E. of 3°E.				S. of 57°N., W. of 3°E.				N. of 57°N., W. of 3°E.	
	March		August		March		August		August	
Age-group										
0	—	—	10.7	150	—	—	—	—	—	—
I	49.1	226	28.5	399	65.2	379	31.5	180	4.3	63
II	5.7	26	9.1	127	6.0	35	13.0	74	12.4	182
III	18.7	86	22.5	314	9.7	56	29.5	168	38.4	566
IV	16.3	75	22.6	317	13.1	75	23.0	131	35.2	518
V	8.9	41	6.0	84	5.7	33	3.0	17	6.6	98
VI	1.3	6	0.6	9	0.3	2	—	—	2.4	36
VII	—	—	—	—	—	—	—	—	0.7	11
Total	100.0 %	460	100.0 %	1400	100.0 %	580	100.0 %	570	100.0 %	1474

Table 35. Average Length of Whiting (in cm.)

Region	S. of 57°N., E. of 3°E.						S. of 57°N., W. of 3°E.						N. of 57°N., W. of 3°E.		
	March			August			March			August			August		
Age-group	♂	♀	Mean	♂	♀	Mean	♂	♀	Mean	♂	♀	Mean	♂	♀	Mean
0	—	—	—	—	—	8.7	—	—	—	—	—	—	—	—	—
I	15.0	15.0	15.0	19.3	19.8	19.5	18.3	18.3	18.3	21.1	21.7	21.4	21.7	21.7	21.7
II	22.6	21.8	22.5	21.9	24.5	23.2	21.8	21.9	21.9	23.9	27.8	25.9	26.1	27.8	26.9
III	25.0	25.8	25.4	24.9	26.6	25.8	25.0	25.9	25.4	27.2	29.3	28.2	27.7	30.0	28.8
IV	26.9	28.2	27.5	26.4	28.7	27.5	25.6	28.8	27.2	28.6	31.0	29.8	29.3	31.9	30.6
V	28.3	31.7	30.0	27.8	32.3	30.0	27.6	32.1	29.8	29.8	34.2	32.0	30.9	34.2	32.6
VI	—	—	31.3	—	—	31.6	—	—	35.5	—	—	—	34.1	38.5	36.3
VII	—	—	—	—	—	—	—	—	—	—	—	—	—	—	44.3

J. Messtorff

Herring

INTRODUCTION

Contributions to the seventh report of the Herring Committee have been received from the following countries:—

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REPORTS

A. Atlantic Waters

YOUNG STAGES

Occurrence of Herring Larvae in Coastal Waters of North-Western Norway

(Figures 1 and 2)

During the last week of March 1955 a series of sections was worked over the coastal banks of western Norway from the Trænabank to Stadt (Fig. 1). Vertical hauls were taken with a metre net, silk No. 0, on 53 stations from bottom to surface.

Herring larvae were numerous at the inner stations from the Haltenbank to Stadt, with maximum occurrence off Möre (2311 larvae per m.²). To the west and north of the Haltenbank and outside the edge of the continental shelf herring larvae were scarce or absent.

The larvae, measuring between 7.0 and 7.5 mm., were recently hatched, and several of them still possessed a yolk-sac.

At the end of April the Haltenbank and Sklinnabank were again investigated, and from 442 to 117

Figure 1. Number of herring larvae per m.² of sea surface on the coastal banks of north-western Norway, 25.—30. March 1955.

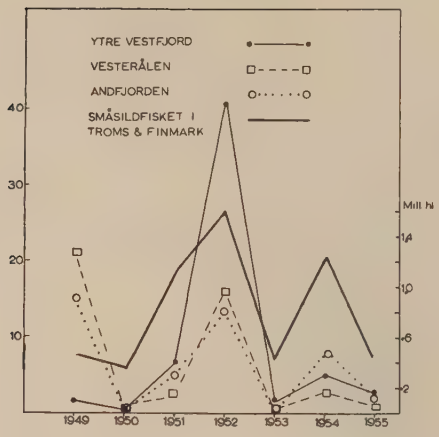


Figure 2. Mean number of herring larvae per m.² of sea surface in coastal areas of northern Norway at the beginning of May of the years 1949—1955 (left scale). Thick line: the output of the small herring fishery in Troms and Finnmark 1949—1955 (right scale).

larvae per m.² were found. Most of these measured from 9 to 12 mm. and a few 14—15 mm.

On the coastal banks further north, from the Vestfjord to the Andfjord, surveys for fish larvae have been carried out each spring since 1948 (Fig.2). There are three peaks in the abundance of herring larvae, in 1949, 1952 and 1954, and there is a very good correlation between the numerical variation of the larvae and the yield of the small herring fishery in the same years, in the two northernmost districts of Norway, Troms and Finnmark, (Fig. 2). One must remember, however, that the statistical term "small herring" on some occasions may consist of two year-classes, the 0-group and the I-group.

It is assumed that the small herrings present in the northernmost parts of Norway mainly originate from the spawning areas from the Haltenbank and northwards. Further south, the herring larvae may drift farther out, along the edge of the continental shelf, and perhaps may be carried very far into the open ocean. In July and August huge quantities of the 0-group of herring have been observed between the edge of the Lofoten Islands and more than 200 naut. miles westwards.

Kr. Fr. Wiborg

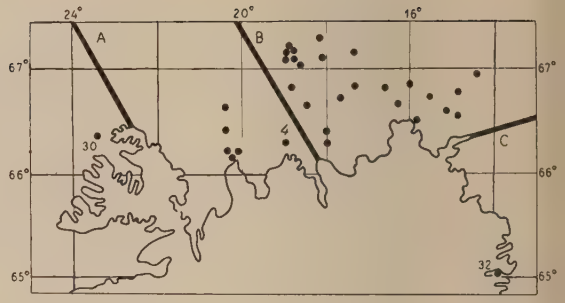


Figure 3. Localities of sampling in 1955.

COMMERCIAL FISH

Iceland

The Icelandic North Coast Herring in 1955

(Figures 3–6 and Tables 1–9)

After failing yields during a period of 10 years, the number of vessels engaged in herring fishery off the north coast of Iceland in 1955 was much fewer (132 vessels) than in the previous year (189). During 1950—1955 the total yields of this fishery have been as follows:—

1950 ...	34,335 tons	1953 ...	42,568 tons
1951 ...	58,903 ,,	1954 ...	26,600 ,,
1952 ...	11,176 ,,	1955 ...	22,600 ,,

The figures show that the total catch in 1955 was less than in any previous season with exception of 1952.

In Figure 3 the localities from which the samples originated are shown and it is seen that the main fishing took place in area B, mostly far offshore. The samples in area A were derived from drift-net catches in August except Sample 4 which came from a purse-seine catch in July. The Samples 30 and 32 came from occasional catches. Concerning the material it is worth to note, 1) that the herrings in Samples 30 and 32 are entirely different from the proper north coast herrings, 2) that the drift-net herrings are slightly different from the purse-seine caught herrings, and 3) that Sample 4 differs from the other purse-seine herrings and is more similar to the drift-net caught variety.

The length of the north coast herring in 1955 can be seen from Table 1 and Figure 4.

Some samples (917 fish) taken by the research vessel "Ægir", using the purse-seine, mostly far offshore, are included in the table. The size distribution of the purse-seine herring shows a peak at 36 cm. as it did last year, but there is no sign of an

Table 1. Size Distribution of Herring (‰)

cm.	Purse-seine	Drift-net	Tagged	"Ægir"	Sample 30	Sample 32
40	—	—	1	3	—	—
39	10	18	13	32	—	—
38	78	78	109	124	—	—
37	257	**246**	**330**	**304**	—	9
36	**311**	210	320	296	**24**	—
35	153	148	135	118	24	13
34	76	120	52	56	60	22
33	68	**126**	30	39	**74**	35
32	37	40	7	14	66	102
31	9	12	2	8	169	194
30	1	2	1	5	**337**	**374**
29	—	—	+	—	192	176
28	—	—	+	1	42	62
27	—	—	+	—	12	9
26	—	—	—	—	—	—
25	—	—	—	—	—	4
Total ...	1000	1000	1000	1000	1000	1000
Number .	2696	500	9203	917	166	227
Av. length	35.72	35.40	36.21	36.18	30.71	30.41

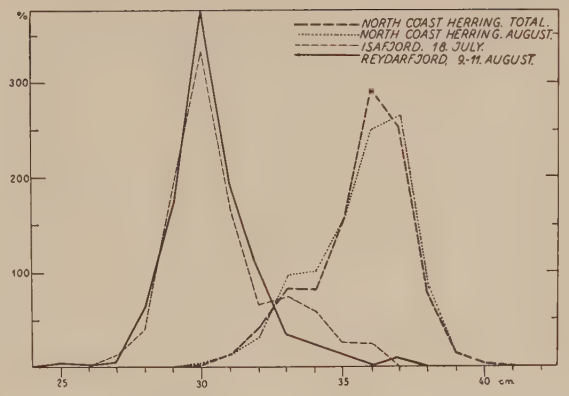


Figure 4. Size distribution of herring. The herrings from "Ægir" are not included in the "north coast herring".

other peak at 32 cm. as in 1954, but this is however true concerning the drift-net herring (peak at 33 cm.). In 1954 there was a considerable difference between the length of the herrings in July and August, the average lengths being 35.15 and 34.36 cm. respectively. In 1955 there was only a suggestion of such a difference, as the mean length in July was 35.90 and in August 35.63 cm. In the case of the herrings taken by "Ægir", there was a considerable difference in size in July and August, the average length being 36.65 cm. in July and only 35.93 cm. in August. All things considered there has therefore been a tendency towards smaller herring in August, but not so clearly expressed as in the previous years. This tendency can only be explained by assuming a withdrawal of the relatively large ocean herrings and the consequent poor yield during the latter half of the season. Taken as a whole, the size of the herrings caught by "Ægir" and that of the tagged herring, proved to be considerably larger than the size of the commercial herring (see Table 1). This is probably due to the fact that these herrings were measured just when coming out of the water.

A glance at Table 1 and Figure 4 shows that the herrings in Samples 30 and 32 are absolutely different in size from all other samples examined during the season. This is seen extremely clearly from Figure 4. As mentioned earlier, Sample 4 (see Figure 3) which was taken in a purse-seine in coastal waters on 7. July, differs from the other samples. The average length was only 33.1 cm.

If the commercial catches are considered, the average size of the herrings has had a tendency to increase until 1953. In 1954 the length was much smaller, but increased again in 1955. This appears clearly from the following figures:—

1951	35.20 cm.	1954	34.92 cm.
1952	35.36 ,,	1955	35.70 ,,
1953	35.79 ,,		

The age composition and the relative strength of the tribes in the commercial catches are given in Table 2 and Figure 5. We find 19 year-broods in the catches (1933—51) and the age ranges from 4 to 22 years. In the Northern Norwegian tribe (NN) there are the same dominating broods as last year, but 1944 (hatched) is somewhat stronger than earlier (Ann. Biol., Vol. XI, p. 116). The same applies to the Southern Norwegian tribe, where there is no difference between 1954 and 1955 with the exception that there is a slight relative predominance of the 1941-brood (14-year-old herring). The average of the two tribes is exactly the same as for 1954, 14.9 and 11.1 years respectively.

In the two Icelandic tribes, the spring spawning (ISPR) and the summer spawning one (ISUM) there is also a fine agreement with 1954. There are two dominants in each tribe, with the same number of annual rings in the scales, but, whereas the youngest one, in both cases, was absolutely predominating in 1954, the reverse is the case in 1955, where the oldest one is predominating (see Figure 5).

In good agreement with this, the average age of these tribes was considerably higher in 1955 than in 1954, being 8.0 (6.2 in 1954) for the ISPR and 8.3 (6.2) for the ISUM (see Table 2). All this considered, it is evident that no new elements have entered the stock during 1955.

Table 2. Age of North Coast Herring in 1955

Age	Year	NN	NS	ISPR	ISUM	?[1])	Total
4	1951	—	—	16	16	—	7
5	1950	5	—	128	95	—	57
6	1949	4	—	**313**	**270**	—	**137**
7	1948	6	45	44	79	109	33
8	1947	**20**	**183**	14	32	94	47
9	1946	19	59	58	16	203	46
10	1945	65	42	**364**	**381**	16	**191**
11	1944	99	**240**	27	63	125	93
12	1943	**105**	**221**	10	—	16	81
13	1942	27	59	8	16	156	28
14	1941	49	**74**	4	16	109	36
15	1940	76	32	**13**	16	156	43
16	1939	107	17	1	—	—	42
17	1938	**153**	13	—	—	—	**58**
18	1937	**157**	9	—	—	—	**59**
19	1936	31	4	—	—	16	13
20	1935	34	2	—	—	—	13
21	1934	**41**	—	—	—	—	**15**
22	1933	2	—	—	—	—	1
Total		1000	1000	1000	1000	1000	1000
Number		995	471	1115	63	64	2708
?[2])		165	7	—	—	316	488
Grand Total		1160	478	1115	63	380	3196
‰		412	169	396	23	—	1000
Av. age		14.9	11.1	8.0	8.3	—	11.1

[1]) Scales not fit for determination of type.

[2]) Scales not fit for age reading.

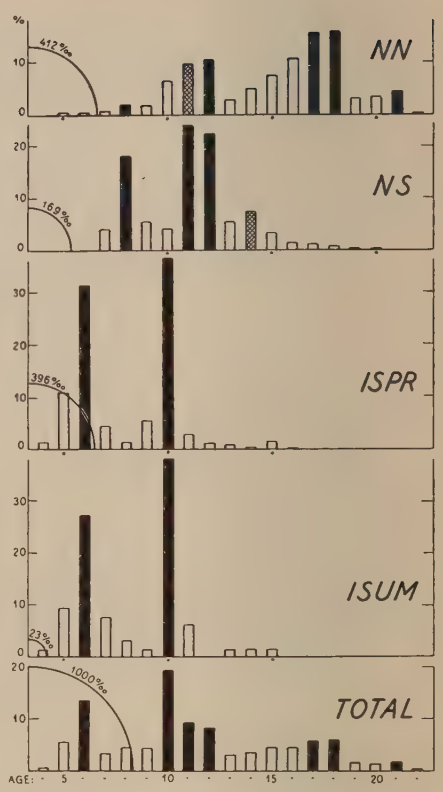


Figure 5. Age distribution in the different tribes of the north coast herring 1955 and the relative number of fish in each tribe (circles at left).

NN = North Norway type.
NS = South Norway type.
ISPR = Icelandic spring spawners.
ISUM = Icelandic summer spawners.

Table 3. Comparison of the Age Composition of some Samples and Groups of Samples

Age	Commercial catches (T. 2)	Samples from "Ægir"	Sample 4	Sample 30	Sample 32
3	—	6	—	53	374
4	7	11	10	**620**	**525**
5	57	22	296	116	20
6	**137**	**83**	**316**	106	61
7	33	27	10	32	—
8	47	43	21	10	—
9	46	62	51	—	—
10	**191**	**181**	102	53	10
11	93	96	10	10	10
12	81	94	31	—	—
13	28	21	—	—	—
14	36	37	41	—	—
15	43	46	10	—	—
16	42	53	10	—	—
17	**58**	**100**	**31**	—	—
18	59	65	41	—	—
19	13	18	10	—	—
20	13	14	10	—	—
21	**15**	**21**	—	—	—
22	1	—	—	—	—
Total ...	1000	1000	1000	1000	1000
Number	2708	626	98	95	99
Av. age .	11.1	11.5	8.5	4.8	3.9

In Table 3 the main features in the age composition of the herring from different parts of the material are shown. It appears that the herring from "Ægir" agrees pretty well in age with the herring from the commercial catches, and that Sample 4 differs from other samples in the commercial catches by having many more young and much less old fish. It is also seen that Samples 30 and 32 are entirely different from the main material, as regards the age composition.

Speaking about the average age in the different tribes, Table 4 shows that there has been a slight trend towards lower age from 1952 to 1955, although the age in 1955 is a little higher than in 1954. This applies to the commercial catch as a whole, and not to the Icelandic tribes, as can be seen from the table.

Table 4. Average Age of Tribes

Tribe	1952	1953	1954	1955
NN	14.7	15.0	14.9	14.9
NS	12.4	11.4	11.1	11.1
ISPR	7.3	6.3	6.2	8.0
ISUM	6.0	8.1	6.7	8.3
Total catch	12.9	12.0	10.7	11.1

In order to compare the relative strengths of the tribes in different parts of the material in 1955 and in the commercial catches from year to year, Tables 5 and 6 have been compiled. Table 5 shows that the commercial catches consist mainly of Norwegian herring (581‰) but also of Icelandic spring spawners (396‰). Only about 25% of Sample 4 is of Norwegian origin, the remainder being Icelandic spring spawners. In the two occasional samples, Nos. 30 and 32 there are no Norwegian elements and the Icelandic summer spawning tribe forms the bulk of these catches.

Table 5. Relative Strength of Tribes in 1955[1])

Category	NN	NS	ISPR	ISUM	Total
Comm. catches	**412**	**169**	**396**	23	1000
Sample 4	184	71	**745**	0	1000
Sample 30	—	—	260	**740**	1000
Sample 32	—	—	160	**840**	1000

[1]) The material from "Ægir" has not been compiled with regard to types.

The figures given in Table 6 indicate that the relative decrease of the Norwegian tribes and the increase of the ISPR, which has been going on for some years, seems to have ceased, but the decrease of the ISUM is continued.

Table 6. Commercial Catches Composition by Tribes during 1952—1955

Year	NN	NS	ISPR	ISUM	Total
1952	666	156	94	84	1000
1953	565	175	171	89	1000
1954	412	160	391	37	1000
1955	412	169	396	23	1000

The number of vertebrae is shown in Table 7, where the distribution and the mean number for each tribe is given. When compared with 1954 it appears that the figure for the NN is exactly the same (57.18), the figure for NS is somewhat higher (57.12 in 1954), it is lower for ISPR (57.22 against 57.27 in 1954) and much lower for the ISUM (56.75 against 57.01). The uncertain group (?) seems to be of mixed origin, but as a whole the mean figure is nearly the same as last year (57.19 against 57.18).

Table 7. Total Number of Vertebrae (V.S.)

V.S.	NN	NS	ISPR	ISUM	?	Total
60	—	—	—	—	1	1
59	17	5	17	1	10	50
58	317	136	340	7	91	891
57	693	283	638	31	230	1875
56	128	53	109	23	48	361
55	5	1	11	1	—	18
N	1160	478	1115	63	380	3196
M	57.18	57.19	57.22	56.75	57.17	57.19
± m	0.02	0.03	0.02	0.09	0.02	0.01

In Table 8 the number of vertebrae in relation to the different stages of maturity is shown. The Tables 7 and 8 comprise only the commercial catches, including Sample 4.

Table 8. Number of Vertebrae according to Maturity

Stage	N	M	± m
II	21	57.19	0.11
III	1200	57.22	0.02
IV	60	57.28	0.09
V	4	57.00	?
VI	—	—	—
VII	—	—	—
VIII	1911	57.16	0.02
Total	3196	57.19	0.01

The maturity appeared to be about normally advanced. The maturity factor (MF) amounted to 2.0 as compared with 1.7 in 1954, 2.3 in 1953 and 2.1 in 1952. The relative number of fish (‰), where the MF exceeded 5 (the gonads weighing more than 5% of the total body weight) was 35 in 1955, 25 in 1954, 89 in 1953 and 34 in 1952. The index of intestinal fat was the same as during the latest years, it was 1.7 in 1955, 1.6 in 1954 and 1.7 in 1953.

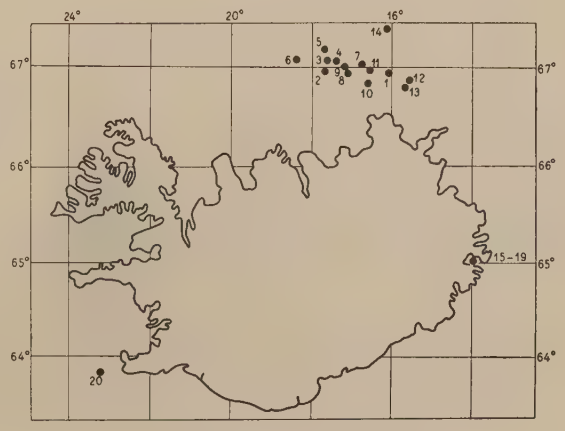


Figure 6. Localities of herring taggings in 1955.

Still fewer tags were recorded than in 1954, only 35 altogether, all from north coast herring, but none from the south and south-west coast and none from Norway. During the winter season in Norway (1955) 387 north coast tags were found. In 1955 returns were recorded from all the north coast tagging experiments (1948—55) as appears from Table 9.

Table 9. Tags returned in 1955

Year of tagging	Returns from Norway	Returns from Iceland	Total returns
1948	1	—	1
1950	4	1	5
1951	19	3	22
1952	132	6	138
1953	110	7	117
1954	121	13	134
1955	—	5	5
Total	387	35	422

ÁRNI FRIÐRIKSSON

Icelandic South Coast Herring

(Figures 7–11)

Fluctuations in size

Data concerning the size distribution of the southern Icelandic herring are available from 1931 to 1955, with the exception of the two years 1942 and 1944. During the period 1931—1954, 48,500 herrings were measured, and a survey of these measurements displays some interesting fluctuations in the size composition of the Icelandic stocks of herrings as shown in Figure 7 (p. 163).

The herrings are divided into the following four size categories:—

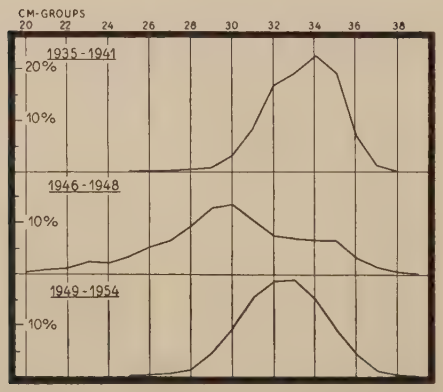


Figure 8. Average size distribution of the southern Icelandic herring during three periods.

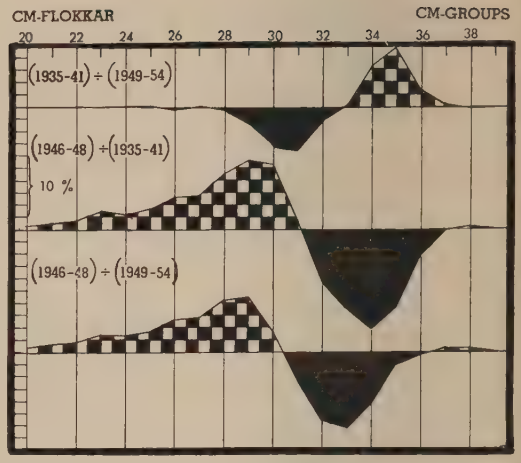


Figure 9. Comparison of averages for the three periods by means of size deviations.

1) Small herring <27 cm.
2) Medium herring 28—31 cm.
3) Large herring II 32—33 cm.
4) Large herring I >34 cm.

It appears that three periods can be distinguished (the material from the years 1931—1934 is too scanty to be used in this comparison):—

1) The period 1935—1945 when large herring, mainly Large I, predominated in the catches.
2) The period 1946—1949 when small and medium herrings predominated, and
3) The period 1950—1954 when large herring predominated again.

These periods correspond to fluctuations in the drift-net fishery on the south-west Icelandic grounds, which was profitable during the first period, failed completely in the second, and was resumed again in 1949. During the second period large concentrations of small and medium herrings were found in Hvalfjord and a rather extensive purse-seine fishery was developed during 1946—1948.

The average size distribution is shown in Figure 8 for the three periods mentioned. It must be presumed that the selectivity of the drift-nets affects the curves for the first and third periods, whereas the purse-seine catches in the second period are more representative.

The size differences are clearly seen by comparing the averages for the three periods as shown in Figure 9 where size deviations are graphically presented.

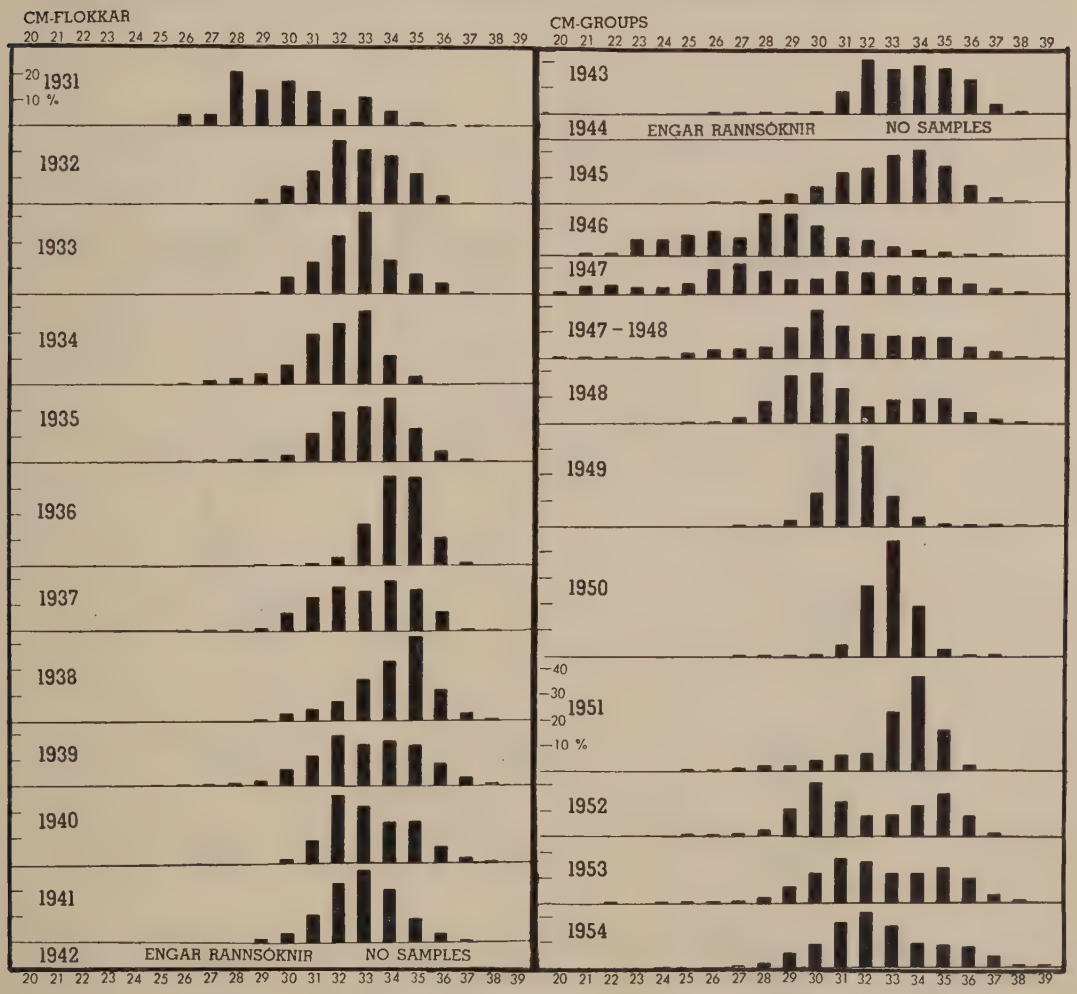


Figure 7. Percentages of size categories (see text) in the southern Icelandic herring during 1931—1954.

Size and age distribution during 1949–1955

Since 1949 we have, in the south Icelandic herring investigations, made use of the otolith method of racial analysis, and with a small margin of error we have been able to determine the age and size composition of the two respective seasonal races of Icelandic herring, the spring spawners and the summer spawners. A survey of the results of these analyses is presented in Figures 10 and 11.

The age composition. When this series of observations began in 1949, strong 4-ringed year-classes entered the south-west Icelandic herring grounds, viz. the summer spawners hatched in the summer of 1944 and the spring spawners hatched in the spring of 1945. In previous years the year-classes 1943 (summer spawners) and 1944 (spring spawners) were dominant. During 1949—1951 the age composition remained almost unaltered, the four year-classes mentioned (summer 1943 and 1944; spring 1944 and 1945) forming about 80—90% of the catches. During these years, new strong year-classes did not appear.

In 1952 3-ringed year-classes (summer 1948, spring 1949) made their appearance and greatly changed the percentage frequencies. These year-classes were still quite numerous in 1955. However, new strong year-classes were observed in 1954,

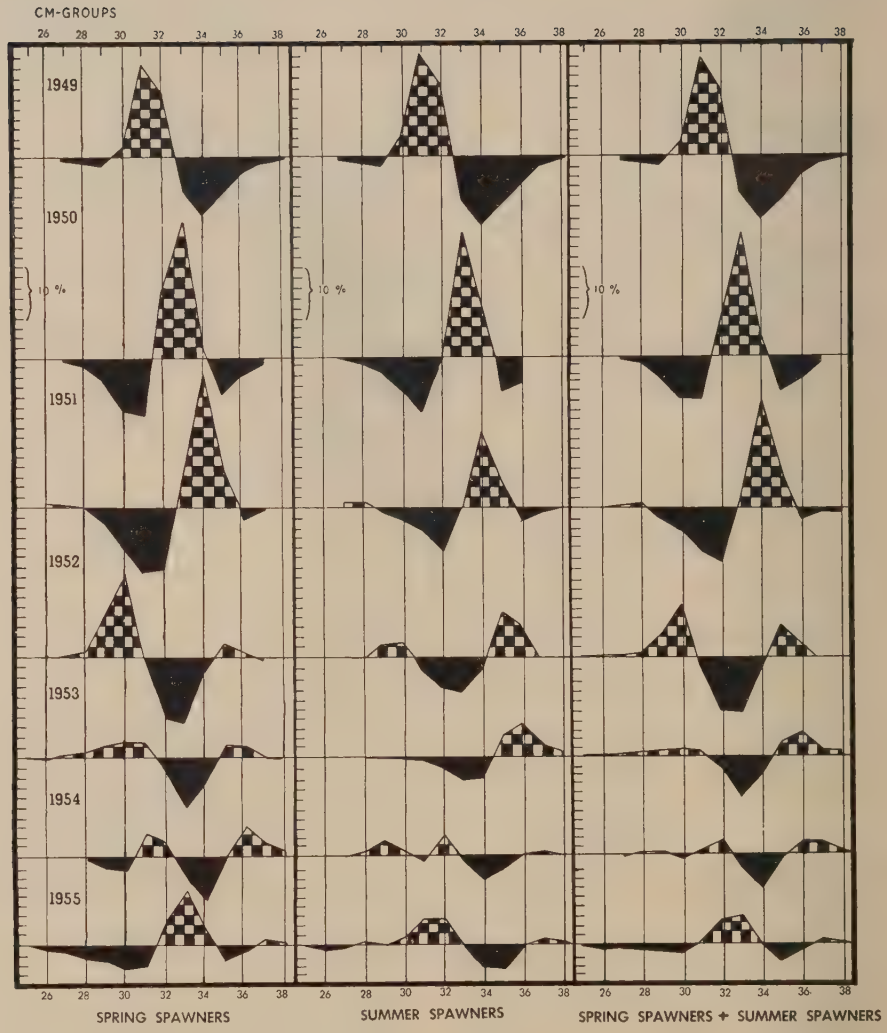


Figure 11. Size deviations of the southern Icelandic herring based on averages for the period 1949—1955.

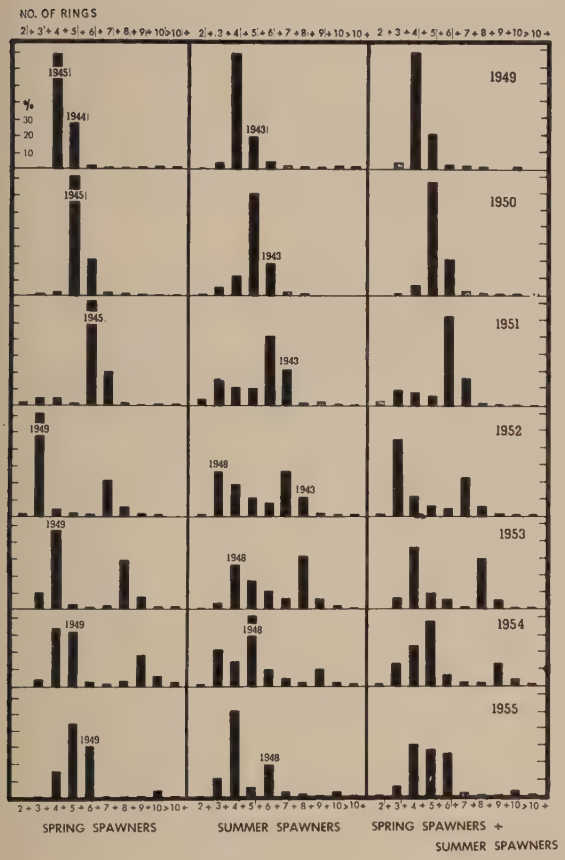


Figure 10. Age composition of the southern Icelandic herring during the years 1949—1955.

4-ringed in the spring spawners (spring 1950) and 3-ringed in the summer spawners (summer 1950) and these year-classes dominated the catches during 1955 to the extent of about 44 and 52% respectively, and because of the adequate recruitment during recent years, the catches were good during 1955.

Size deviations. From the measurements made during 1949—1955 the size deviations were calculated, and are graphically shown in Figure 11. This figure shows rather strikingly the influence of the dominant year-classes on the size composition. It appears quite clearly that large herring (>32 cm.) have been rather abundant from 1950 onwards, in striking contrast to the period 1946—1949 when the catches consisted mainly of small and medium herrings. These years have therefore proved profitable to the salting industry.

HERMANN EINARSSON

Records from the Month of June of the Norwegian-Icelandic Herring Stock in the Open Ocean

(Figures 12 and 13)

After preliminary research into the occurrence of the Atlanto-Scandian stock of herring in the open Norwegian Sea over a series of years, it is now possible to combine some of the results from the month of June in the adjoining charts (Figs. 12 and 13) for the years 1954 and 1955. The charts show the temperature conditions in a depth of 20 m., and on the routes of the research vessels "Dana", "G.O. Sars", and "Ægir" the records of herring obtained by Asdic or echo-sounder are indicated. It is hoped that the experiences obtained during the years since 1948 will make it possible in future to follow such alterations which may occur in the distribution and migration of the herring in this important oceanic herring area, and that the information given in charts similar to those appended may be useful both to the fishery research work and to the industry.

The first information of recent years from this important herring area was published in *Annales Biologiques* for the year 1948, when the R/V "Dana" carried out a preliminary survey of the area between E. Iceland and the Faroes from 19. July to 14. August (see Ann. Biol., Vol. V, pp. 19—21); herring samples obtained in the area showed that the herring were similar to Norwegian and north Icelandic herring. Faroe fishermen carried out that year some drift-net fishing of herring in the area north-east of the Faroes, and great herring concentrations were observed by a Faroe trawler 7.—8. August in the same year about 140 miles E.N.E. of Langanes in north-east Iceland. In that year also, Dr. Á. FRIÐRIKSSON and Mr. O. AASEN initiated internal tagging of herring both off Iceland and off Norway, and, as is now well known, those experiments resulted in the valuable proof of the important interchange of herring between the two areas.

An increasing interest in the fishing possibilities of this herring stock became obvious, and a new era in the north-east Atlantic herring fishery was started during the following years, and it is now acknowledged that the basis for this new fishery in the open ocean was entirely due to the use of the echo-sounder and the Asdic.

At the meeting of the North-Western Area Committee on 6. October 1948 it was recommended that a special investigation of the Atlanto-Scandian stock of herring in the Norwegian Sea should begin during the summer of 1949 and a common plan for the work was agreed upon.

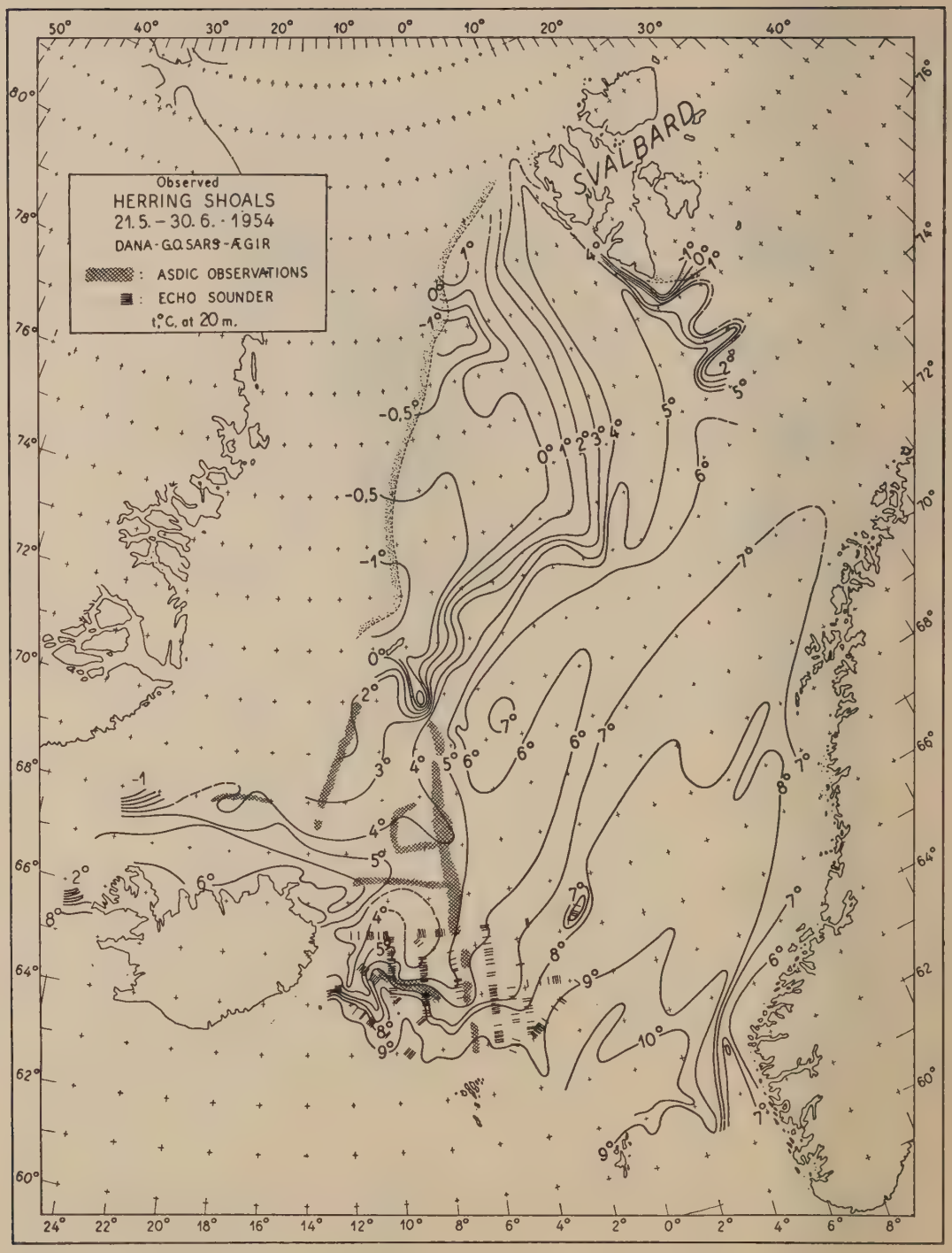

Observed
HERRING SHOALS
21.5. – 30.6. - 1954
DANA - G.O.SARS - ÆGIR
: ASDIC OBSERVATIONS
: ECHO SOUNDER
t°C. at 20 m.
SVALBARD

Figure 12.

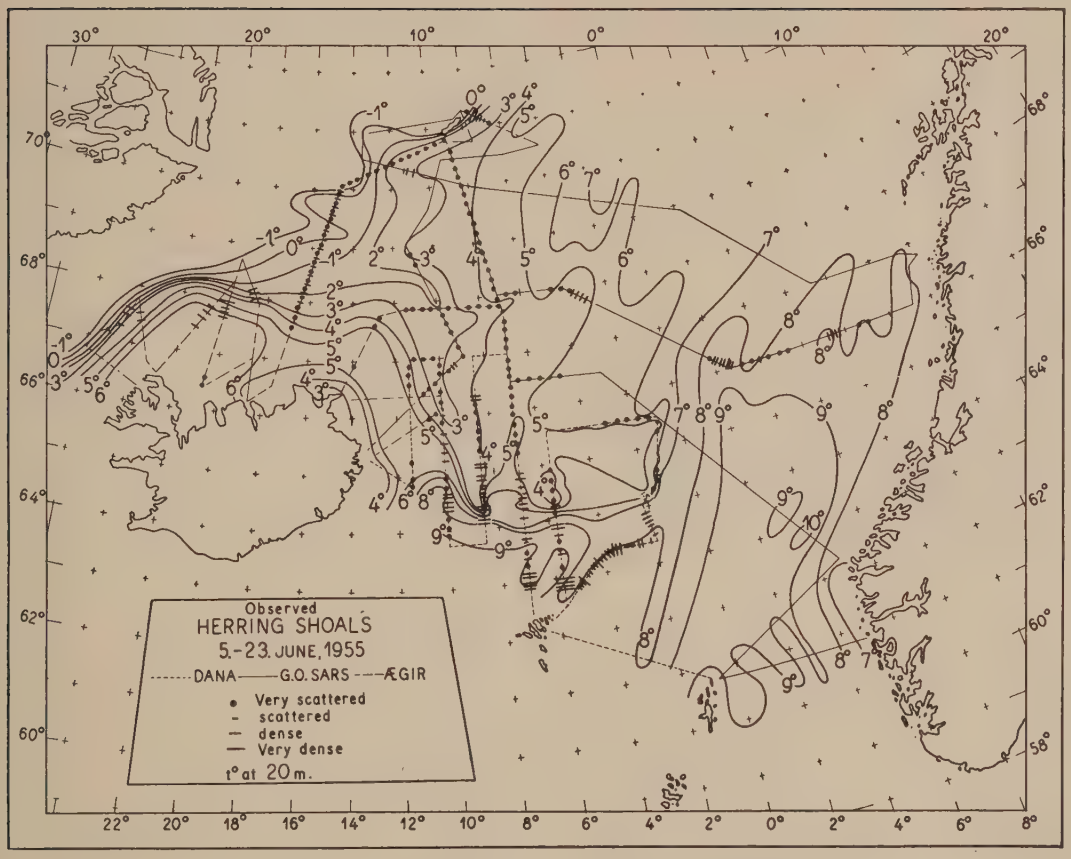


Figure 13.

The observations in the Iceland-Faroe area during the summer of 1948 led to the proposal, in 1949, by the Danish Minister of Fisheries, Mr. Chr. Christiansen, that the herring researches should be conducted on an inter-Scandinavian basis, and a special inter-Scandinavian Herring Committee has been operating since that year and has greatly furthered the work in the herring area.

In 1949 Denmark, Iceland, Norway, Scotland, and Sweden carried out research in the area according to the North-Western Area Committee programme. The Norwegian vessel M/S "Vartdal" recorded that year herring in several places of the area during June (see Ann. Biol., Vol. VI).

In *Annales Biologiques* of the following years the results for the month of June, obtained by hydrography, Asdic, echo-soundings, and fishing operations are reviewed briefly.

The main season for the combined investigations has been the month of June, but several observations were obtained also at other seasons, especially during August—January. The results obtained during the month of June by the research vessels from Iceland, Norway, and Denmark have been, since 1952, considered by the leaders of the operations at meetings held in late June, and general statements of the actual conditions have been immediately distributed to the benefit of the fishing industry.

Å. Vedel Tåning
H. Einarsson
J. Eggvin

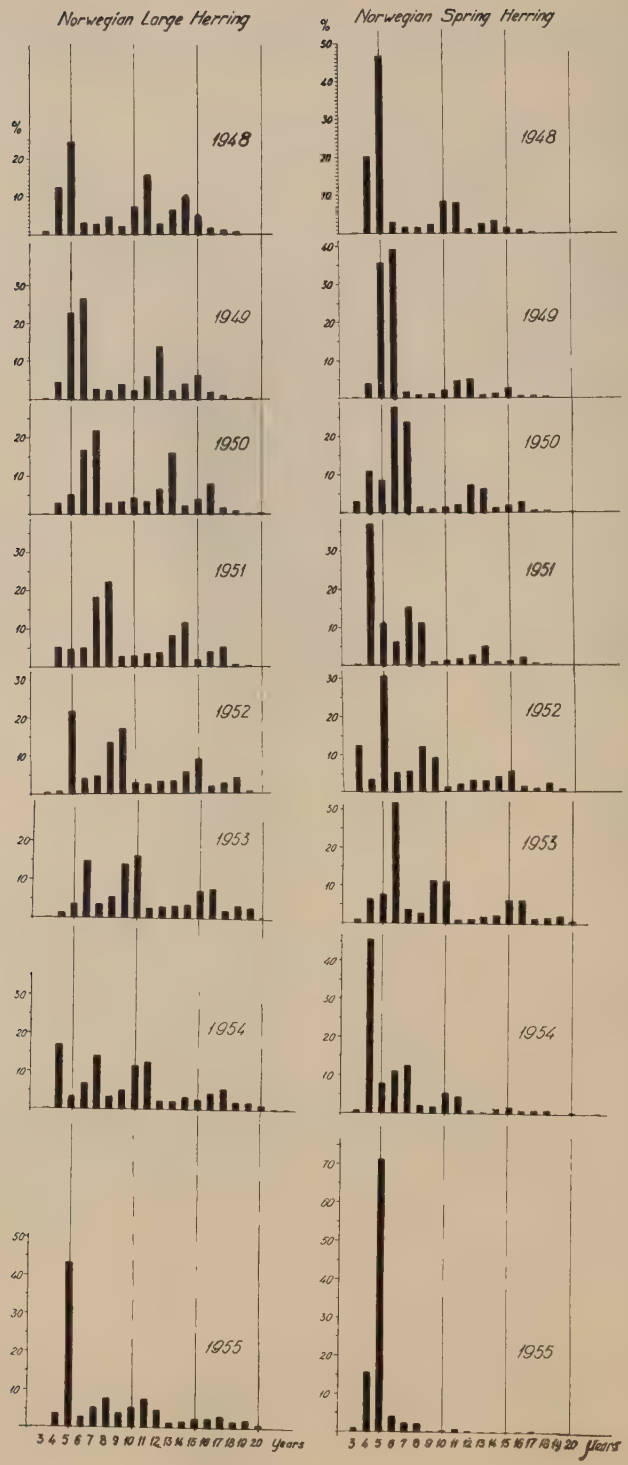

Norwegian Large Herring
Norwegian Spring Herring
%
1948
1949
1950
1951
1952
1953
1954
1955
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 Years

Figure 14.

North and North-East of the Faroe Islands
Occurrence of Herring

The area in question was, as in previous years, surveyed by the R/V "Dana" in June, north to about 67°N. and between about 1° and 13°W. The researches were arranged as part of a general programme agreed upon by Denmark, Iceland, and Norway.

The hydrographical researches are dealt with in the section on hydrography of the Distant Northern Seas area, pp. 26—27, Figures 32—35. The distribution of herring observed by echo-sounder is shown in Figure 13 on p. 167 in relation to the temperatures in a depth of 20 metres.

The main features are similar to those of the preceding years in the month of June, with slight alterations, viz., that dense herring concentrations were recorded nearer to the north-east coasts of the Faroes than before. This was in accordance with the fact that the "cold tongue" reached farther south than in 1954; the situation was more like that in 1953.

The plankton distribution was studied by Hensen-net hauls and the use of the Plankton Indicator.

Information service to the Faroe herring fleet was arranged during the season, and by this service the position of dense herring concentrations observed by drifters with echo-sounders was reported by radio telephone, as far as possible daily, from Thorshavn to the Faroese fishing vessels in the area. The catch per drift-net unit was reported from the various parts of the area.

The number of vessels operating was much lower than in 1954 owing to the fact that U.S.S.R. was not sufficiently interested in the catch. Some 90 vessels salted about 90,000 barrels of herring.

Å. Vedel Tåning

Norwegian Sea

(Figures 14–16)

During the winter season 1955, 31 samples, totalling 6150 herrings, were secured.

Figure 14 gives the age distribution for the years 1948—55. *Large herring* includes all herring caught in Norwegian coastal waters north of Bergen. *Spring herring* includes herring caught farther south, off the coast. The herring hatched in 1950 from a very strong year-class as was mentioned in last year's report (Ann. Biol., Vol. XI). A glance at Figure 14 shows that the older year-classes are sparsely represented in recent years. This may be the result of the expansion in the fishery. Figure 15 shows the total landings of the

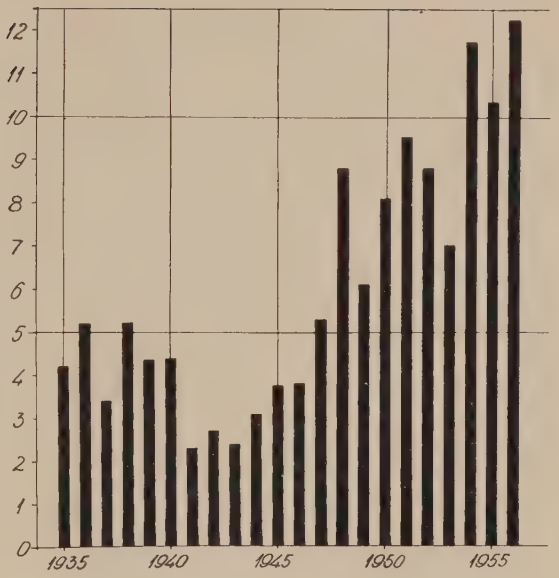


Figure 15.

winter herring fishery since 1935. It is still an open question if the increased fishing is responsible for the decline in the representation of the older year-classes, or if the decline is due to the 1950 year-class being so rich that all the other year-classes are suppressed. If the first mentioned alternative is true, then we can already see the result of the increase in the fishing. But if the decline in the older year-classes in our samples is a result of a very rich year-class, which now for the major part has reached maturity, the mature stock has received an unusually big recruitment from the immature stock. If we compare the age distribution of the spring herring of 1955 with the age distribution of the spring herring of 1910 (Ann. Biol., Vol. I) we get a similar picture. In 1910, the mature stock received such a great recruitment from the famous 1904 year-class that Lea has calculated that the size of the stock was about ten times as great as the stock was in 1907, before the 1904 year-class entered the mature stock. It may be that the 1950 year-class, which in the last three years has reached maturity, will be responsible for as great an expansion of the stock as the 1904 year-class was 45 years ago. The large output of the last season (1956) supports this idea, and the fact that we still have herring more than 20 years old in our samples points in the same direction. The tagging experiments also indicate that the stock of mature herring has greatly increased, for the number of recovered tags per

million hl. of herring processed in the Norwegian plants show a marked decline, which must be interpreted as an increase of the stock (see Table 10 in DRAGESUND's contribution).

In January we again succeeded in following the mature herring from the area north of the Faroes to the Norwegian coast, and reports of the approach of the herring were given directly from the R/V "G.O. Sars" to the Norwegian fishermen three times every day. After the arrival of the herring in Norwegian coastal waters, and after the actual fishing had started, the area westwards from the coast to the Faroes was again investigated and shoals were still found in the cold water of the East Icelandic Arctic Current between west and north of the Faroe Islands. The Atlantic water between the Faroes and the Shetlands was searched by Asdic, but no herring were found in this area in spite of favourable weather.

The migrations of the shoals southwards along the Norwegian coast to the spring herring district were also investigated, and it seems as if the shoals are moving southwards in the coastal water.

During the summer of 1955, two cruises were made by the R/V "G. O. Sars" in the Norwegian Sea. The first cruise, with Dr. EGGVIN in charge, collected hydrographic data and located the herring shoals in collaboration with the Danish and Icelandic research vessels. The three research vessels met late in June in Seydisfjord, Iceland, and charts of temperature conditions and concentrations of herring shoals were prepared and distributed to the fishermen.

On the second cruise, in August—September, with Mr. DEVOLD in charge, additional hydrographic observations were made. It was especially the area north-east of Jan Mayen which we intended to investigate but a break-down in the engine of "G. O. Sars" made it necessary to return to Bergen soon after these investigations had started, and the rest of the time for which the "G. O. Sars" was commissioned for herring investigations was used in the area south of Jan Mayen. The position of herring shoals was reported to the Norwegian fishing fleet three times a day. In September, the shoals moved southwards along the eastern edge of the East Icelandic Arctic Current, then during the latter part of September the shoals penetrated the spring layer of the cold water and herrings were located down to a depth of about 200 metres.

During the cruise, 3 samples were secured for further investigations. The age composition is given in Figure 16, and according to TH. RASMUSSEN's examinations of the scales, Sample 2 is to a

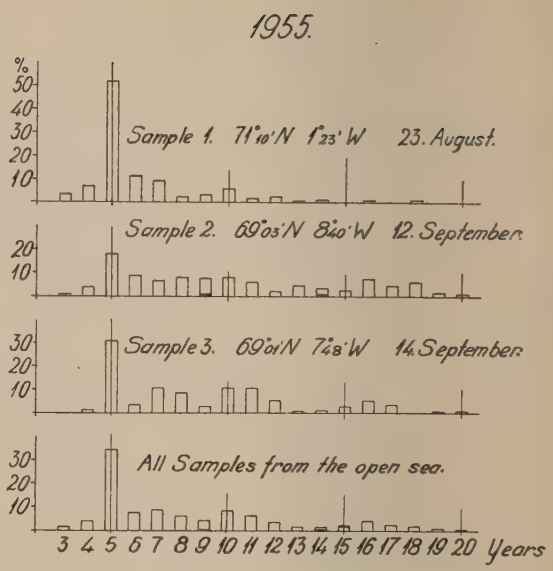

1955.
%
50
40
30
20
10
Sample 1. 71°10'N 1°23'W 23. August.
Sample 2. 69°03'N 8°40'W 12. September
Sample 3. 69°01'N 7°28'W 14. September
All Samples from the open sea.
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 Years

Figure 16.

small degree mixed with Icelandic summer spawners. The age composition of the herrings caught in the open sea also shows that the 1950 year-class is very abundant. The experiments on the catching of herrings located by Asdic with the purse seine were continued with very promising results.

In November and December, cruises were undertaken to the Skagerak and Norwegian Sea. Herring concentrations on the slope from the North Sea banks down to the Norwegian Channel were investigated from the Jutland Bank to the Viking Bank. The migration route of the Atlanto-Scandian herring was located north of the Faroes in the cold water of the East Icelandic Arctic Current, and the hydrographical conditions were investigated at the same time.

FINN DEVOLD

Tagging Experiments

(Figure 17 and Table 10)

In 1955 we also tagged large and spring herring, about 10,000 of each category.

In April—May, after the close of the winter herring fishery, we tagged 6,599 "forfangstsild", that is recruit spawners mixed with fat herring, in various localities between Bergen and Stadt.

The fat herring taggings in 1955 (8,400) were carried out in August—September at four localities in Northern Norway between Tana Fjord and Trondheim Fjord and in all experiments both

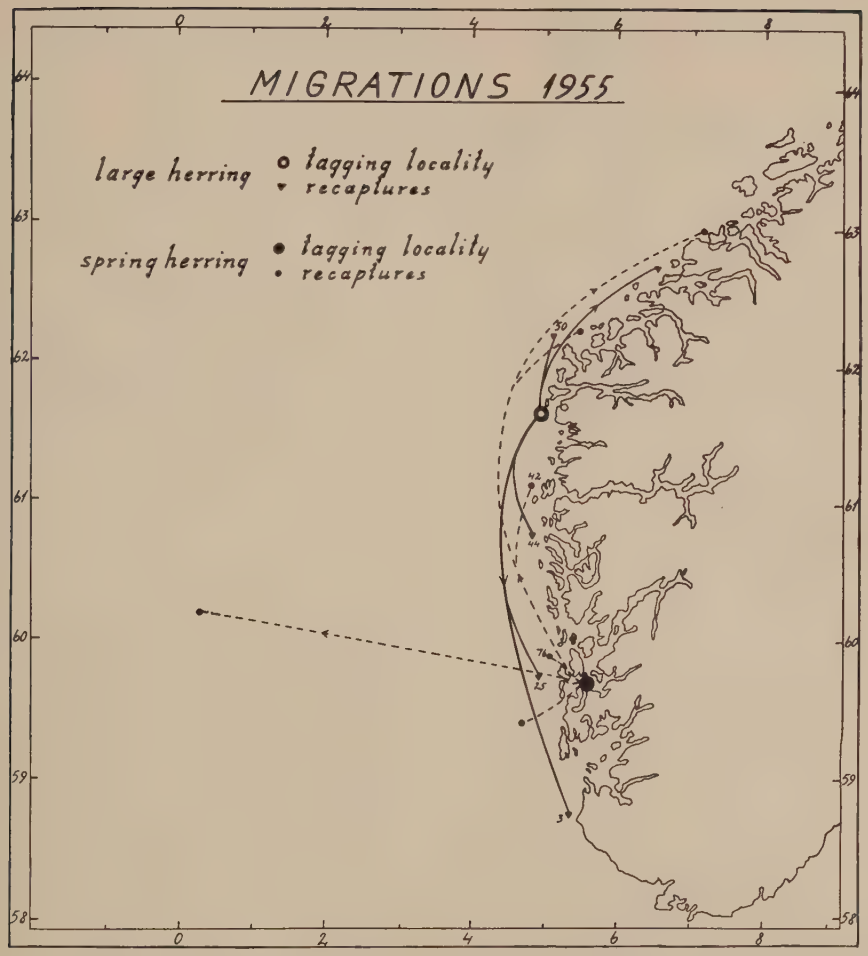


Figure 17. The distribution of the recoveries in 1955 of large herring tagged from 3.—11. February 1955, and spring herring tagged in the same year from 11. March to 3. April.

internal and external tags were used, as well as a combination of the two.

Figure 17 shows the distribution of the recoveries in 1955 of large herring tagged from 3.—11. February 1955 and spring herring tagged from 11. March to 3. April in the same year.

It will be noted that the large herring migrated both north and south from the tagging site, but most of these were recovered in the spring herring district between Florö and Haugesund.

Only 8 days after the tagging, the first specimen was recaptured south of Haugesund. Apparently the herring shoals were stopped here by the cold water front, which was moving northwards along the coast. This is probably the reason why we got no recoveries from the Skagerak and the North Sea. Also the "one-sided migration" northwards by the spring herring tagged in 1955 shows that the herring avoids the cold coastal water.

In Table 10 is shown a summary of the recoveries in 1955; the year of tagging and the numbers and categories of herring tagged are given. The within season recoveries are not included. The figures in brackets represent the recaptures expressed as per mille returns per million hectolitres.

We notice that these figures are a little lower for the open ocean herring in 1955 than in preceding years, and this phenomenon may be explained in part by the good recruitment to the stock in 1955.

Table 10. Number of Returns in 1955 for the different Experiments and Returns per Million Hectolitres in $^0/_{00}$ (Figures in Brackets)

Year of tagging	Category	Numbers tagged	Year of recapture 1950	1951	1952	1953	1954	1955
1948	SH	6,018	14 (1.30)	12 (0.74)	23 (0.87)	15 (0.74)	15 (0.43)	7 (0.25)
1948	OH	7,475	9 (0.67)	7 (0.35)	9 (0.28)	9 (0.36)	12 (0.28)	1 (0.03)
1949	SH	8,261	26 (1.75)	22 (0.98)	25 (0.68)	17 (0.61)	44 (0.92)	16 (0.41)
1950	LH	9,085	—	14 (0.57)	14 (0.35)	10 (0.33)	16 (0.31)	9 (0.21)
1950	SH	11,215	—	9 (0.30)	9 (0.18)	8 (0.21)	12 (0.19)	7 (0.13)
1950	OH	1,827	—	10 (2.03)	16 (2.00)	13 (2.10)	13 (1.23)	8 (0.95)
1951	LH	5,998	—	—	23 (0.87)	22 (1.08)	27 (0.78)	18 (0.65)
1951	SH	9,986	—	—	63 (1.41)	60 (1.77)	68 (1.18)	57 (1.24)
1951	OH	5,076	—	—	55 (2.48)	54 (3.14)	84 (2.86)	31 (1.32)
1952	LH	10,295	—	—	—	18 (0.52)	26 (0.44)	14 (0.29)
1952	SH	10,763	—	—	—	73 (2.00)	107 (1.72)	137 (2.76)
1952	OH	17,308	—	—	—	246 (4.19)	328 (3.27)	116 (1.45)
1953	LH	10,080	—	—	—	—	19 (0.33)	8 (0.17)
1953	SH	10,046	—	—	—	—	37 (0.64)	47 (1.01)
1953	OH	10,181	—	—	—	—	274 (4.66)	105 (2.24)
1954	LH	10,042	—	—	—	—	—	24 (0.51)
1954	SH	10,291	—	—	—	—	—	86 (1.81)
1954	OH	8,783	—	—	—	—	—	121 (1.91)

LH = Large herring
SH = Spring herring
OH = Open ocean and north coast herring

Herring tagged off the Icelandic coast and in the open ocean generally yield relatively more returns than do the herring tagged on the Norwegian coast. The year 1948 was an exception. The large herring usually give the lowest recoveries. The spring herring tagged in 1950, however, form an exception.

It is natural to ask whether the large herring are shedding the tags more easily than do the spent spring herring, or if the tags cause greater mortality if inserted before spawning than after.

Last winter, therefore, we tried to carry out shedding tests, and also to do some experiments on tagging mortality. 500 tagged and 500 untagged herring were separately enclosed in a cove situated in the large herring district, but unfortunately, a fortnight later, we lost the greater part of the herring in bad weather. Until this happened 8.2% of the untagged and 2.6% of the tagged herring had died.

The herrings that were not lost through bad weather were kept for about 4 months in captivity, and in this period it was noticed that the wound caused by the insertion of the internal tag was completely healed after 3.5 months, leaving only a small scar. These experiments will be continued next winter.

Olav Dragesund

B. North Sea and Adjacent Waters

YOUNG STAGES

Autumn-Spawned Herring Larvae in the Northern North Sea

Scottish sampling of autumn-spawned herring larvae in 1955 was carried out over the same area as in the preceding year. At least part of this area was covered in each of the following periods: 11.—18. August, 29. August—2. September, 7.—13. September, 4.—10. October, 18. October—2. November, 25. November—5. December, and 30. November—21. December.

When the first survey was carried out larvae were found only in two areas—one off Noss Head (Caithness) where they were fairly abundant—and a patch, significantly less dense, on the western edge of Turbot Bank. On this survey, there was no sampling north of Noss Head, so that the patch located there might well have been the southern fringe of an extensive larval distribution around Orkney. All the larvae taken on this cruise ranged from 7 mm. to 10 mm. which, taken with their restricted distribution, would suggest that hatching had just started at this time.

On the following survey the region around Orkney and the Moray Firth were sampled fairly extensively, but the grounds off the Aberdeenshire coast were not covered at all. Around Orkney heavy concentrations of larvae were located in Westray Firth, off North Ronaldsay, and most particularly off Auskerry and, within the Moray Firth, again off Noss Head. South of this larvae were still absent or very sparse. The bulk of these larvae were 8—10 mm. long; but mixed with these larger ones were taken, ranging up to 17 mm.

The area covered on the survey from 7.—13. September was not very satisfactory. Two lines of stations were worked off the Aberdeenshire coast which revealed abnormally low concentrations of larvae for this region at this time. The few stations which were occupied to the east of Orkney again located a patch of early larvae off Auskerry, in even greater density than on the preceding cruise. The larvae on the Orkney grounds were again chiefly in the 8—10 mm. size-group. Larger larvae up to 19 mm. were taken on this cruise, but these were all found between Turbot Bank and the Aberdeenshire coast.

The cruise carried out early in October achieved a complete survey of that part of the area south of 58°30′N. Within the Moray Firth the herring larvae had a pronouncedly more southerly distribution than on the preceding cruise. By this time they were taken only in small numbers in the Noss Head region, but were dense to the south of this all over the Moray Firth and eastwards to the prime meridian. The abundance of larvae had also increased over the Turbot Bank area, but was still well below the density normally attained in that area. Hatching was by this time well past its peak, and larvae less than 10 mm. were rather scarce over the area as a whole; they were restricted to the Noss Head area.

The survey carried out in the latter part of October achieved fairly complete sampling to the east of Orkney and in the northern part of the Moray Firth, with a few stations off the Aberdeenshire coast. By this time herring larvae were very sparse except in the latter area. On the last two cruises herring larvae were taken in rather small numbers and were markedly restricted to the western part of the survey area, being largely concentrated in the entrance to the Cromarty Firth, and close in to the Aberdeenshire coast.

Thus the conditions in 1955 resembled those of 1954 in that the products of a heavy spawning, concentrated around the Orkney Islands and in the vicinity of Noss Head, were dispersed southwards over the Moray Firth and on to the banks off the Aberdeenshire coast. The most marked discrepancy between the two years was the paucity of newly hatched larvae over the Turbot Bank area in 1955 throughout the entire hatching period. The spawning on the Orkney grounds would appear to have been somewhat heavier than in 1954. This spawning presumably provided all the larvae which were retained within the survey area by November but, in spite of the heavier initial spawning, larvae were by this time markedly less abundant than in the preceding year. The overall mortality coefficient was about twice that operating in 1954.

A. Saville

Table 11. Catch and Effort Statistics of the "Halflin" Fishery in Upper Moray Firth

	Season									
	1945–46	1946–47	1947–48	1948–49	1949–50	1950–51	1951–52	1952–53	1953–54	1954–55
Duration of season .	6.10.45– 9. 3.46	5.10.46– 29. 3.47	25.10.47– 6.12.47	30.10.48– 8. 1.49	15.10.49– 17.12.49	30. 9.50– 16.12.50	29.9.51– 29.3.52	13.9.52– 21.3.53	12.9.53– 20.2.54	18.9.54– 26.3.55
No. of landings	761	700	79	345	298	365	783	1,631	2,654	1,715
Total catch in crans	3,215	7,958	356	3,409	3,990	2,790	19,066	38,885	61,773	25,263
Catch per landing in crans	4.2	11.4	4.5	9.9	13.4	7.6	24.4	23.8*	23.3*	14.7

* Quota system of 25 crans per boat was in operation during most of these seasons.

COMMERCIAL FISH

0- and I-Group, Scotland 1954—55

(Tables 11, 12, and 13)

The landings of young herring in the winter fishery off the Scottish east coast in 1954—55 were much smaller than during the previous winter. Total landings of "halflins" from the upper reaches of the Moray Firth were less than half the previous year's total, and the catch per unit effort was also considerably less. The landing statistics for this fishery for the period 1945—55 are given in Table 11. The catches per landings show 1) that there was a decided increase in the abundance of "halflins" during the winter of 1951—52, 2) that the higher level of abundance was maintained during 1952—53 and 1953—54, and 3) that the level fell in 1954—55, but still remained higher than for any post-war season before 1951.

Comparable statistics are not available for the landings of "halflins" from the ring-net fishery in the upper reaches of the Firth of Forth which is based on a mixed stock of sprats, 0-group herrings and "halflins". However, estimates have been made of the quantities of "halflins" landed between 1950 and 1955 and these are given in Table 12. There was no increase in abundance in 1951—52 and 1952—53 as there was in the Moray Firth.

The size ranges, mean lengths and mean Vert. S. of samples of 0- and I-group herring from the commercial fisheries and from trawl catches by research vessels are given in Table 13. From the vertebral counts spring-spawned herring were present in strength among the 0-group herring for the first time since 1950—51 but formed only a very small part of the stocks of I-group herring.

G. McPherson

Table 13. Length and Mean Vert. S. of 0- and I-Group Herring caught in the Inshore Waters off the Scottish East Coast in 1954—55

(Numbers in brackets)

Locality	Date	Range cm.	Mean length, cm.	Mean Vert. S.
Autumn 1953 and Spring 1954 Broods				
Firth of Forth	Jan. 1955	8–18	12.18 (308)	56.73 (184)
	Mar. 1955[1])	9–18	12.06 (249)	56.65 (118)
St. Andrews Bay	Oct. 1954	8–10	8.43 (53)	56.90 (45)
	Jan. 1955	8–18	12.39 (432)	56.89 (118)
Aberdeen Bay	Oct. 1954	8–13	10.44 (41)	56.90 (21)
Inverness Firth	Oct. 1954	7–14	10.29 (168)	56.93 (41)
Autumn 1952 and Spring 1953 Broods				
Firth of Forth	Mar. 1955[1])	16–25	20.16 (618)	56.50 (235)
Inverness Firth	Nov. 1954[2])	17–23	20.17 (282)	56.56 (236)
	Dec. 1954[2])	16–25	20.57 (286)	56.64 (284)
	Mar. 1955[2])	18–24	21.09 (200)	56.55 (199)

[1]) Ring-net samples.

[2]) Drift-net samples.

All others caught by trawl.

Table 12. Statistics of "Halflin" Fishery in Upper Firth of Forth

	Season				
	1950–51	1951–52	1952–53	1953–54	1954–55
Duration of fishery	21.10.50–28.4.51	8.12.51–18.4.52	4.10.52–21.3.53	26.12.53–10.4.54	18.10.54–26.3.55
Greatest number of boats engaged	46	45	31	29	22
Estimated catch of "halflins" in crans	6,133	7,911	2,513	13,554	786

Scottish Fisheries 1955

(Tables 14–25, Figures 18–22, and Charts 1–14)

A. North Sea

Commercial Landings

Drift-net fishing was conducted in the North Sea in 1955 from the following Scottish ports: Aberdeen (late March to August), Peterhead and Fraserburgh (April to September), Lerwick (May to August), and sporadically at Wick (June to August).

The fishery in late March, April, and early May from Aberdeen, Peterhead, and Fraserburgh took place in the north-eastern North Sea, but the fleets at these ports later concentrated on the customary grounds in the north-western North Sea.

Landings of trawled herring from the Fladen and Gut grounds were made by Swedish trawlers in the period July—October.

The landings and crude effort statistics for these fisheries for 1955 and the three previous years are given in Table 14.

These statistics show that, despite a continuation of the general downward trend in total effort by the drift-net fleets, the total landings and the landings per unit of effort were higher than in the previous year. The landing per unit effort figures indicate that the abundance of the available stock in 1955 was even higher than in the recent series of "high density" years. The increase in available stock was particularly marked in the Shetland area, where the total catch was over twice as great as the average for the two poor years 1953 and 1954.

There was again a marked trend in the activity of the herring trawlers away from the Fladen area and into the more southerly Gut area.

Detailed statistics of catch and effort for the main drift-net fisheries in each month are given in Charts 1—14. Charts 1—7 give the total number of hauls made in each of a series of "10 mile squares" (10′ latitude by 20′ longitude) in each month, and Charts 8—14 give the corresponding average catches per 100 nets per haul in these squares. Owing to the appointment of additional statistics collecting staff at Aberdeen, it was possible in 1955 to obtain full statistics for this port for the first time, and these are incorporated, together with the data for Fraserburgh, Peterhead, and Lerwick, in these charts.

These data show that the distribution and seasonal trends in fishing effort, and in the centres of stock abundance for 1955 followed the customary broad pattern. In March, April, and early May the main concentrations of herring and centres of fishing were in the region to the east of longitude 1°E., but as the season progressed the fishery moved progressively westward, and in July and August was centred on the grounds to the west of 1°E.

An interesting feature of these statistics, which is also evident in the 1954 statistics (Ann. Biol., Vol. XI), is the substantially greater productivity of the eastern grounds in May than in March and April. While this may be due in part to an increase in the availability of the stock to capture by drift-net, it is probable that there is a substantial influx of the adult members of the autumn-spawning stock into the northern North Sea in late April and early May, probably from grounds futher to the south.

Table 14. East Coast and Shetland Herring Landings, 1952—1955

Drift-Net

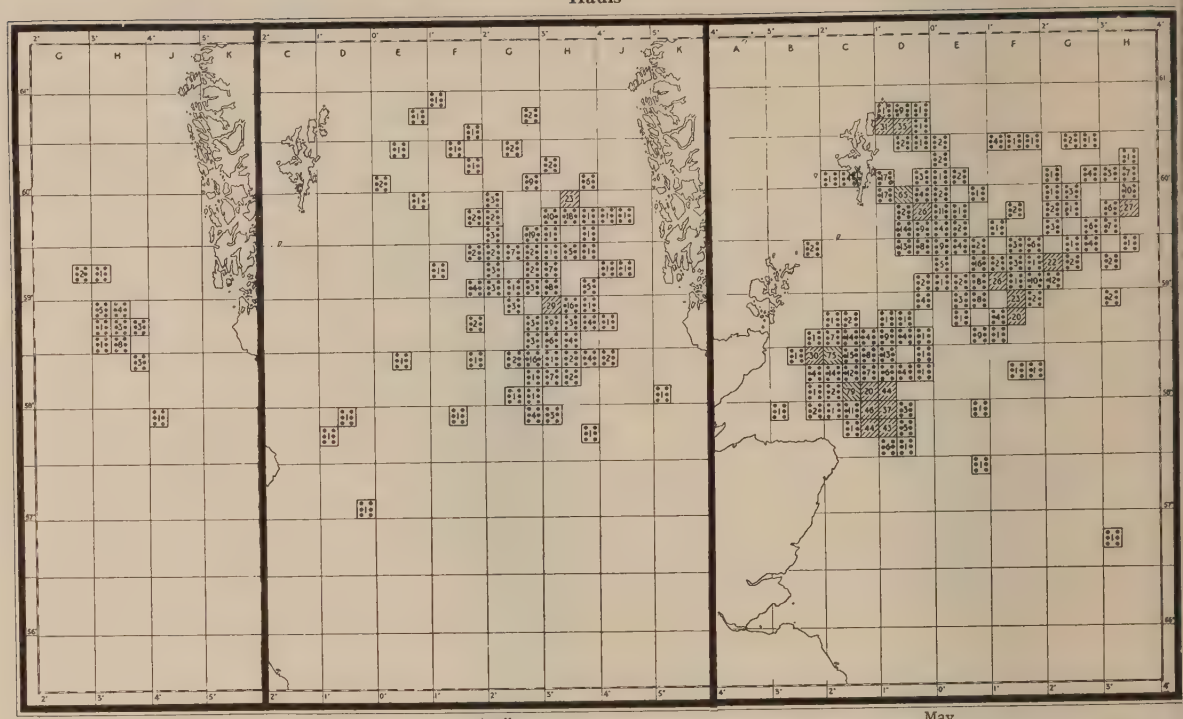
	Landings (crans)				Arrivals				Average landing per arrival[1]) (crans)			
	1952	1953	1954	1955	1952	1953	1954	1955	1952	1953	1954	1955
Fraserburgh ..	188,207	213,285	147,817	171,462	8,468	9,790	6,630	5,740	22.2	21.8	22.3	29.9
Peterhead	106,405	124,762	87,218	89,454	4,072	4,899	3,570	2,984	26.1	25.5	24.4	30.0
Lerwick	49,180	15,666	23,382	43,216	2,415	1,345	1,664	1,733	20.4	11.6	14.1	24.9
Wick	5,994	5,345	4,894	2,614	194	387	242	74	30.9	13.8	20.2	35.3
Aberdeen	62,274	72,217	61,499	73,041	915	1,183	1,000	959	68.1	61.0	61.5	76.2

Trawl

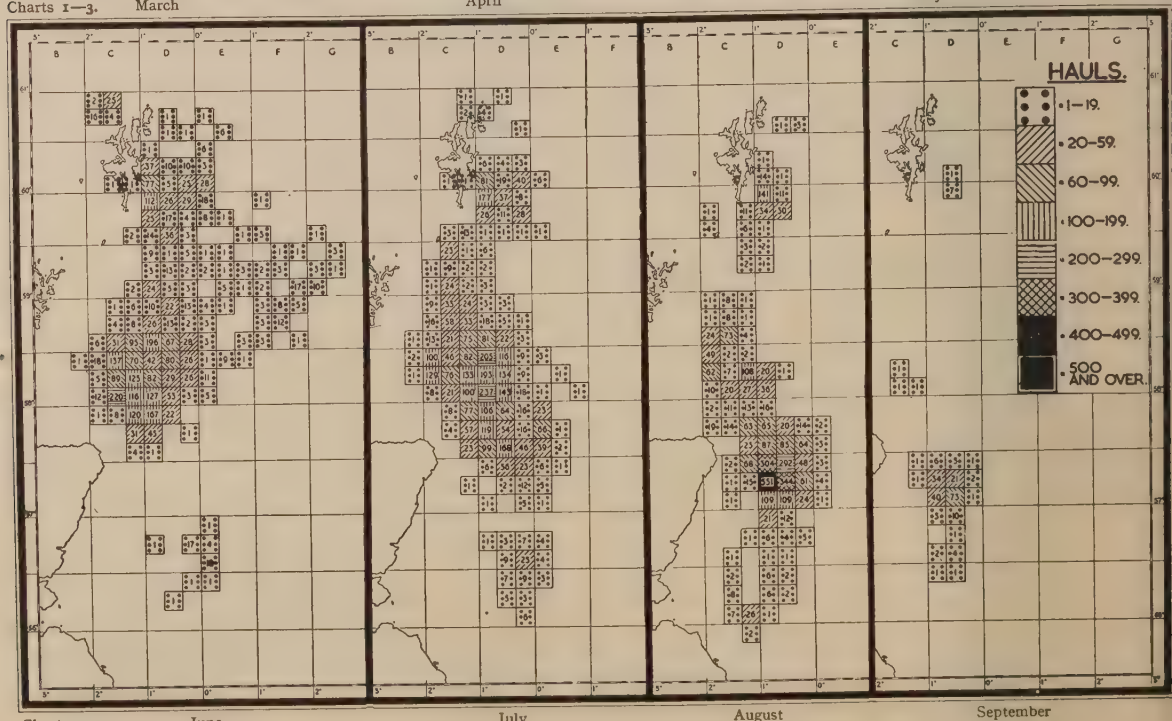
	Landings (crans)				Hours fishing				Landings per 100 hours (crans)			
Fladen	18,983	8,950	3,869	1,268	9,773	3,382	1,502	311	194.2	264.6	257.6	407.7
Gut and southwards.	5,043	8,976	12,057	10,912	1,363	2,391	2,871	3,090	370.0	375.4	420.0	353.1

[1]) These figures are not adjusted to standard number of nets per haul. Each arrival at Aberdeen represents on average two hauls. Each arrival at other drift-net ports usually only one haul.

Hauls

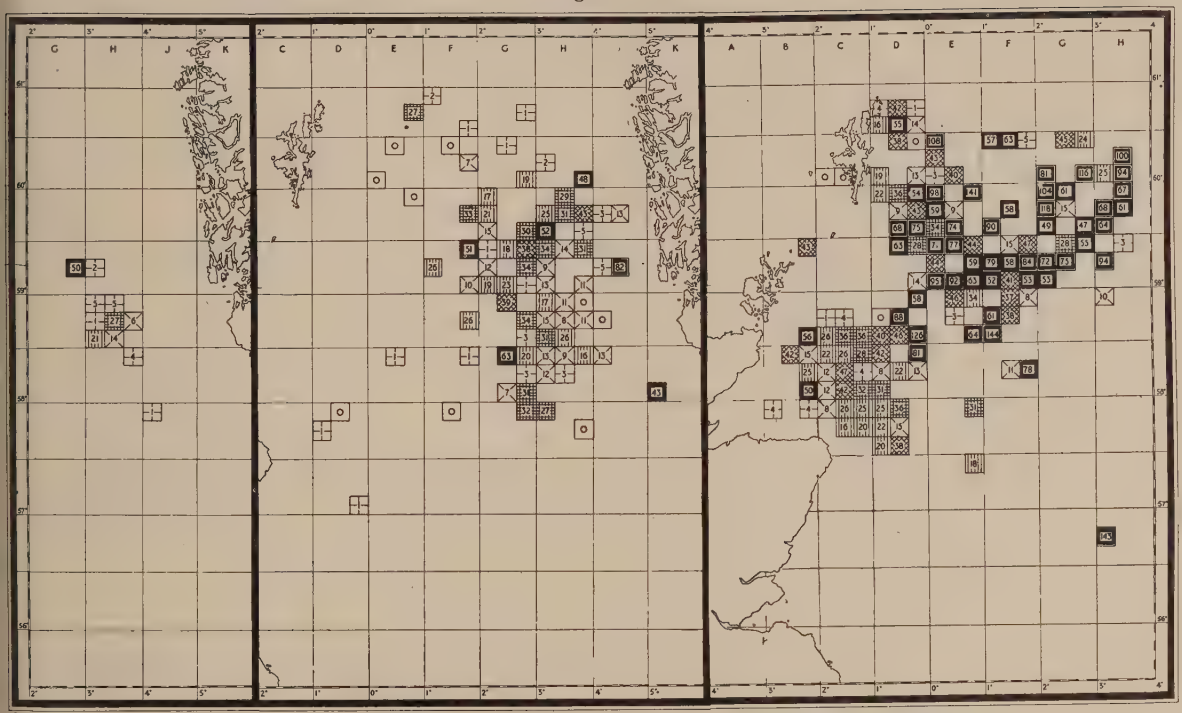


Charts 1—3. March April May

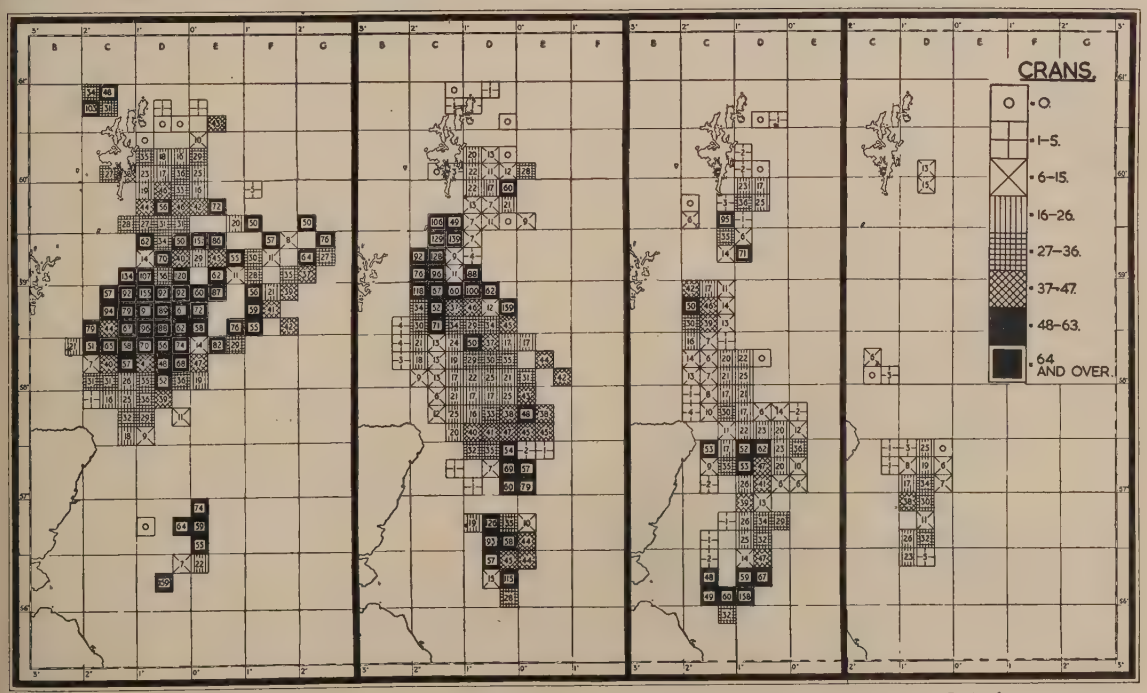


Charts 4—7. June July August September

Average Catch



Charts 8—10. March April May



Charts 11—14. June July August September

Length, Age, and Racial Composition of Samples

Intensive sampling of the drift-net landings at Fraserburgh, Peterhead, and Lerwick was carried out in 1955 on the same lines as in previous years (Ann. Biol., Vols. IX—XI), and the sampling programme was extended to cover the landings of English drifters fishing from Aberdeen throughout the season. Thus, in 1955, the sampling coverage was more complete than in earlier years, and extended over the whole of the area fished by drifters landing at Scottish ports. In particular, the extended sampling programme provided greater coverage of the north-eastern North Sea catches in the period March—June.

North-eastern North Sea (east of longitude 1°E. and north of latitude 58°N.)

Samples were taken at scattered points over the area fished by the drifters in the north-eastern region between March and June 1955. The length and age compositions of these samples are given in Figure 18 and the maturity and Vert. S. data are contained in Table 15.

These data indicate that the stocks fished in the north-eastern area during the period were composed principally of fish between 2 and 6 years of age, with the three-year-old brood (spawned between autumn 1951 and spring 1952) constituting about one-third of the total catch. The maturity and vertebral count data indicate also that the stock was composed of a mixture of spring and autumn spawners. This is confirmed by the results of the analyses of otolith characters, which are presented in Table 16.

It is seen that the autumn spawners outnumbered the spring spawners in the catches from the north-eastern area by about two to one. As in the 1954 samples (Ann. Biol., Vol. XI), the spring spawners consisted almost entirely of age-groups II to V in maturity stages I, VI, VII, and VII—II, but the autumn spawners were represented by a wide range of age-groups mainly in maturity stages I, VII—II, and II.

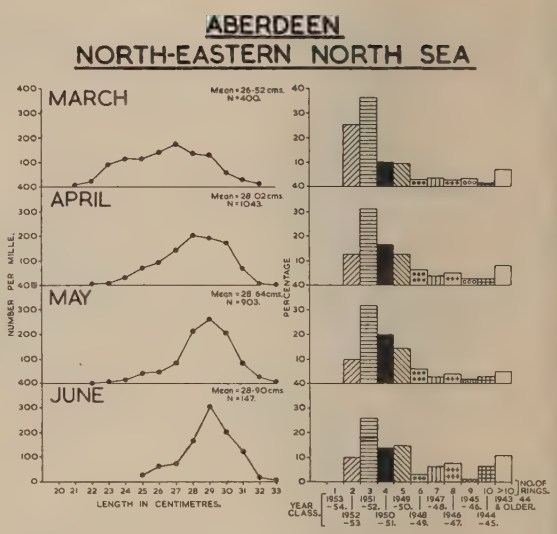


Figure 18. Length and age compositions of north-eastern North Sea drift-net samples. March—June 1955. (Length frequencies unsmoothed).

The proportion of spring spawners in the catches increased from west to east, as did the age composition of the autumn-spawning component. The otolith characters showed that a large part of the spring-spawning component were members of the Atlanto-Scandian stock, while the autumn spawners were part of the main body of adult autumn spawners which were later fished in the north-western North Sea.

North-western North Sea (west of longitude 1°E. and north of latitude 55°30′N.)

The main north-western North Sea drift-net fisheries conducted from the Scottish ports Fraserburgh and Peterhead, and the Shetland port, Lerwick commenced in May 1955 and continued until early September. In late May the main body of the drifter fleet working from Aberdeen, which had earlier fished in the north-eastern area, joined in the main fishery in this area. Daily sampling of landings at each of these ports was maintained

Table 15. Maturity and Racial Characters, North-Eastern North Sea, 1955

	A. Percentage Maturity (All age-groups) Maturity stage								B. Vert. S. (Actual numbers—all age-groups) Number of vertebrae						
	I	II	III	IV	V	VI	VII & VII–II	Numbers	54	55	56	57	58	59	Mean
March	**31.0**	1.8	2.0	0.5	—	14.0	50.8	400	1	11	155	201	24	1	56.61
April	18.7	7.1	0.8	0.7	—	8.8	**64.0**	1043	2	31	390	520	81	4	56.64
May	16.1	**28.7**	0.5	—	—	0.1	**54.5**	750	1	20	244	397	69	2	56.71
June	6.2	**51.6**	6.2	2.1	—	—	**34.0**	97	—	—	40	44	11	—	56.69

Table 16. Age Composition of Spring and Autumn Spawners in North-Eastern North Sea in the Period March—June 1956

Year-class	Winter-rings	Spring-Group Mar./Apr. No.	%	May No.	%	June No.	%	Year-class	Winter-rings	Autumn-Group Mar./Apr. No.	%	May No.	%	June No.	%	Total Sample % Spr.	% Aut.
1953	2	32	8.2	26	8.3	1	4.2	1952	2	179	18.1	48	11.4	9	12.6	20.0	80.0
1952	3	191	48.8	143	45.8	10	41.6	1951	3	246	24.8	96	22.8	15	21.1	49.1	50.9
1951	4	89	22.7	76	24.4	6	25.0	1950	4	124	12.5	68	16.1	7	9.9	46.2	53.8
1950	5	72	18.4	50	16.4	5	20.8	1949	5	85	8.6	55	13.1	8	11.3	46.2	53.8
1949	6	2	0.5	9	2.9	1	4.2	1948	6	64	6.5	36	8.5	2	2.8	10.5	89.5
1948	7	3	0.8	1	0.3	—	—	1947	7	47	4.7	20	4.8	6	8.4	5.2	94.8
1947	8	1	0.3	2	0.7	—	—	1946	8	59	5.9	30	7.1	7	9.9	3.0	97.0
1946	9	—	—	4	1.3	1	4.2	1945	9	41	4.1	13	3.1	—	—	8.5	91.5
1945	10	1	0.3	—	—	—	—	1944	10	37	3.7	18	4.3	6	8.4	1.6	98.4
1944 & older	>10	—	—	1	0.3	—	—	1943 & older	>10	110	11.1	37	8.8	11	15.6	0.6	99.4
Total number of otoliths examined		391		312		24		Total number of otoliths examined		992		421		71		32.9	67.1

throughout the season and the samples were taken over the whole area covered each month by the fleets operating from each port. The statistical squares sampled in each month were as follows:—

Fraserburgh					Peterhead				
May	June	July	Aug.	Sept.	May	June	July	Aug.	Sept.
D 14	C 14	C 14	D 13	D 13	C 14	C 14	C 14	C 13	D 13
C 15	C 15	D 14	D 14		D 14	D 14	D 14	D 13	
B 16	D 15	C 15	C 15		C 15	C 15	C 15		
	C 16								
	D 16	D 16	D 15		D 15	D 15	D 13		
			C 16						

Lerwick				Aberdeen				
May	June	July	Aug.	May	June	July	Aug.	Sept.
D 18	D 18	C 17	C 18	D 15	D 12	D 11	D 11	D 12
D 19	D 19	C 18	D 18	D 16	E 12	E 12	C 12	D 13
D 20	C 20	D 18	D 19	E 16	D 15	D 13	D 12	
		D 19		E 17	E 15	D 14	D 13	
				E 18	C 16	D 15	D 14	
					D 16	C 16		
					D 17	D 16		
					E 17	C 17		
					D 18			

These data show that in May and June the greater part of the Aberdeen fleet fished on grounds further to the east and north than the main body of the other fleets operating from Fraserburgh and Peterhead, but later in the season the fleets from all three ports fished mainly on grounds off the east coast of Scotland.

The length and age compositions of the samples taken throughout the season at Aberdeen and at Fraserburgh, Peterhead, and Lerwick are presented in Figures 19 and 20 respectively, and the corresponding maturity and Vert. S. data are given in Tables 17 and 18.

The most striking feature of the stocks fished from these ports was the overwhelming dominance of the two-year-old brood (two winter-rings) in the Fraserburgh-Peterhead area in May, June, and July. In this period this brood constituted over 70 per cent. of the fish sampled at these ports, and in May and June it and the three-year-old brood (three winter-rings) together constituted over 90 per cent.

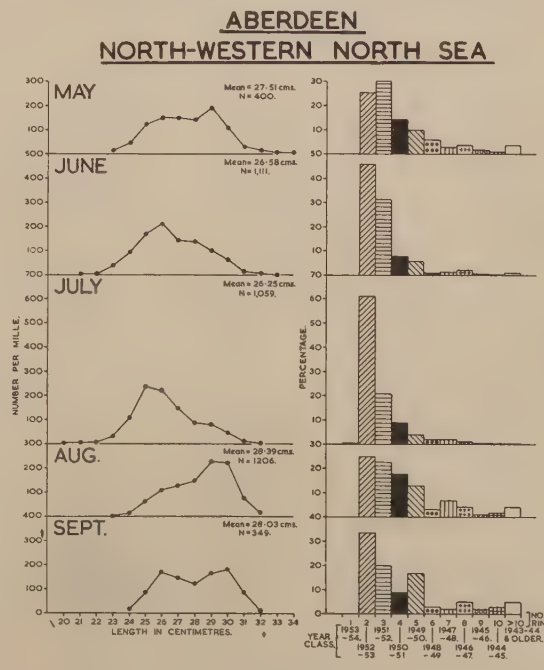


Figure 19. Length and age compositions of north-western North Sea drift-net samples. May—September 1955. (Length frequencies unsmoothed).

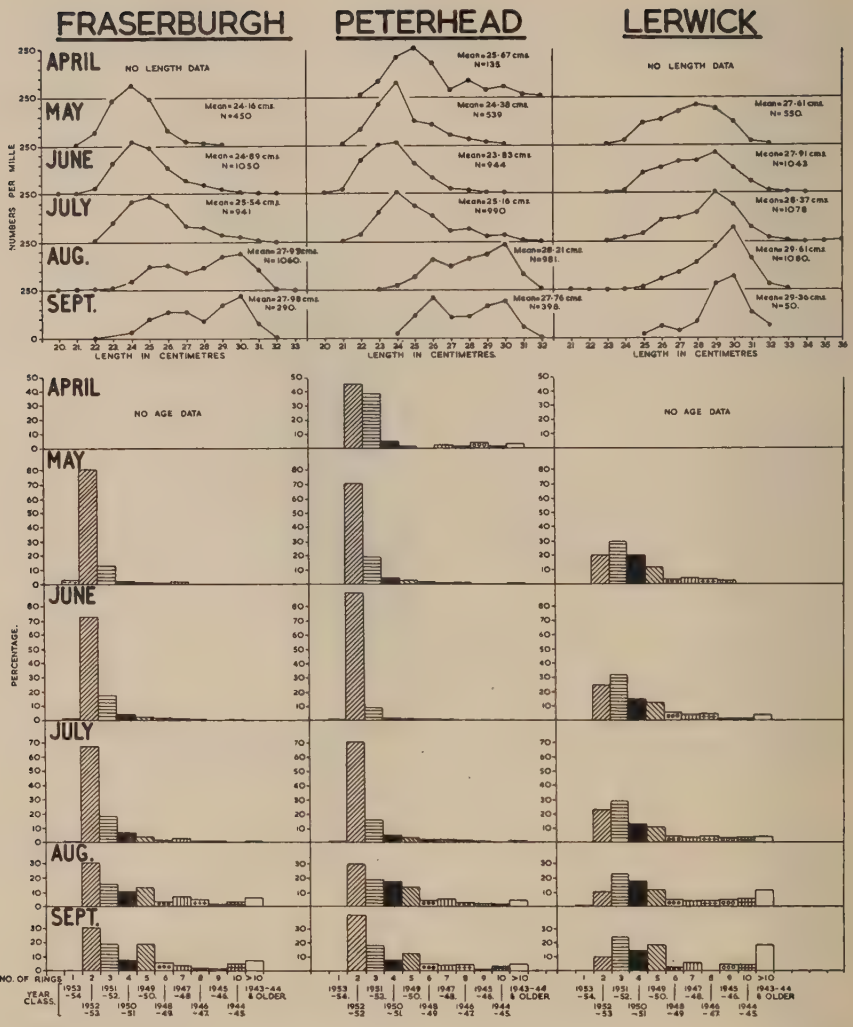


Figure 20. Length and age compositions of north-east coast and Shetland drift-net samples. April—September 1955. (Length frequencies unsmoothed).

Table 17. Maturity and Racial Characters, North-Western North Sea, Aberdeen Drifters, 1955

	A. Percentage Maturity (All age-groups) Maturity stage								B. Vert. S. (Actual numbers—all age-groups) Number of vertebrae						
	I	II	III	IV	V	VI	VII & VII–II	Numbers	54	55	56	57	58	59	Mean
May	25.0	32.3	1.8	—	—	—	41.0	400	—	12	161	194	17	1	56.57
June	17.2	40.5	19.2	4.2	0.7	—	17.5	548	—	14	262	236	22	—	56.50
July	9.6	18.2	29.8	21.8	11.0	7.1	2.5	648	—	34	287	285	30	—	56.49
August	—	1.7	5.3	9.3	26.9	39.4	17.3	900	1	32	426	396	32	—	56.48
September	0.3	1.4	2.6	16.9	13.8	42.7	22.4	349	—	22	160	149	8	—	56.42

Table 18. Maturity and Racial Characters, North-Western North Sea, Fraserburgh, Peterhead, and Lerwick Drifters, 1955

A. Percentage Maturity (all age-groups)

	Fraserburgh					Peterhead					Lerwick				
Maturity stage	May	June	July	Aug.	Sept.	May	June	July	Aug.	Sept.	May	June	July	Aug.	Sept.
I	**47.3**	**28.7**	9.9	2.3	—	**39.5**	32.8	11.6	0.3	—	10.3	13.5	10.2	5.2	—
II	**45.1**	**46.9**	**21.2**	1.4	1.3	**41.7**	**49.0**	22.1	0.8	0.3	15.8	**33.1**	16.5	11.2	—
III	0.2	10.2	**29.9**	4.8	1.3	0.5	8.6	29.9	5.7	2.0	0.3	15.0	**25.2**	5.9	—
IV	0.2	3.0	16.8	10.4	9.3	—	1.7	17.9	10.2	7.5	0.5	5.2	16.7	7.9	4.0
V	—	0.6	13.6	21.2	13.3	—	0.7	13.8	**21.4**	11.1	—	1.3	7.1	13.5	**36.0**
VI	—	—	6.6	**36.2**	**28.7**	—	—	3.0	**41.3**	**48.5**	0.3	—	3.3	11.2	18.0
VII & VII–II.	7.1	10.6	2.1	**23.7**	**46.0**	**18.4**	**7.2**	1.7	**20.3**	**30.7**	**23.1**	**31.9**	**21.0**	**45.1**	**42.0**
No. of fish....	450	697	619	519	150	441	594	593	635	398	200	1043	1078	1080	50

B. Vert. S. (actual numbers—all age-groups)

No. of vertebrae															
54	1	1	2	1	1	—	—	—	—	—	—	—	3	—	—
55	17	27	14	28	8	16	18	20	25	22	5	30	24	39	2
56	187	285	297	243	72	192	252	272	280	201	70	402	410	458	26
57	215	328	266	223	67	196	277	264	304	156	95	508	528	512	20
58	13	32	26	16	1	27	26	16	9	14	16	87	86	55	1
59	—	2	1	—	—	—	1	1	2	—	1	1	2	—	—
Mean	56.51	56.55	56.50	56.44	56.40	56.54	56.55	56.49	56.49	56.41	56.67	56.64	56.64	56.55	56.41
No. of fish....	433	675	606	511	149	431	574	573	620	393	187	1028	1053	1064	49

of the total. This important feature follows the trend in recent years towards decreasing average age of the stock on these grounds in the May-July period and the increasing dependence of the fishery on the two-year-old recruit brood. This trend is clearly shown in Table 19, which gives the percentage age composition of the combined May-July samples from Fraserburgh and Peterhead for each of the years 1950 to 1955.

These data show that the percentage and total number of two-year-old fish in the catches have increased sharply since 1950, while the percentage and abundance of the older age-groups have decreased. This general trend has also been recorded in other North Sea herring fisheries (Ancellin: Ann. Biol., Vol. IX; Hodgson: Ann. Biol., Vol. XI).

It is evident from Figures 19 and 20 that the two-year-old recruit brood was not the dominant one in the catches from the Shetland grounds in the May—July period, nor on the grounds fished by the Aberdeen drifters in May. Not until the Aberdeen fleet shifted its centre of fishing to the same general area as the Fraserburgh-Peterhead fleets in June did this brood appear as the dominant one. Clearly, the age composition of the exploited stock in the north-western North Sea in the May—July period increased from south to north. This feature is of importance in assessing the population dynamics of the herring stocks in the northern North Sea; it illustrates the need for detailed catch and effort statistics and age and "racial" data for the whole area fished in this region before attempts can be made to interpret the changes in age composition and abundance on the Scottish east coast grounds.

As in previous years (Ann. Biol., Vols. IX, X, XI), the age composition of the Fraserburgh, Peterhead, and Aberdeen catches changed markedly in August, when the fishery was centred principally on the spawning concentrations off the east coast of Scotland. It is evident that a large proportion of the two-year-old recruit brood emigrated from the area fished by the Scottish fleets in late July and August, and an older adult spawning population concentrated on the Scottish east coast spawning grounds. In consequence the trend in age composition shown for the pre-spawning concentrations is not revealed in the August—September samples.

These results, given in Table 20, show that the relative proportions of the younger age-groups have fluctuated between wide limits since 1950, but no marked trend in age composition is evident, such as is revealed in Table 19.

A marked feature of the samples taken during the season is the similarity between the age compositions and Vert. S. counts of the Shetland catches in May, June, and July, and the north-eastern North Sea catches from March to June. These data indicate, as in previous years (Ann. Biol., Vols. X and XI), that the main body of the stocks fished at Shetland in the summer months invaded the local grounds from the east. Otolith analysis of the Shetland samples showed also a mixed population

Table 19. Percentage Age Composition of Fraserburgh and Peterhead Samples in May—July, 1950-55

Year	Age (winter-rings) 1	2	3	4	5	6	7	8	9	10	>10	Number of fish
1950	0.02	**12.17**	**40.26**	17.91	9.69	6.37	6.58	3.94	1.61	0.88	0.57	5481
1951	0.27	**10.33**	**22.90**	31.30	13.33	7.50	5.01	4.49	3.05	1.10	0.72	5549
1952	—	**31.48**	**17.27**	16.44	15.99	7.10	4.03	2.56	2.41	1.60	1.13	5391
1953	0.31	**38.53**	**28.56**	9.71	7.34	7.00	3.47	1.90	0.97	1.23	0.97	4212
1954	0.48	**61.25**	**18.65**	8.15	3.49	3.14	2.17	0.88	0.63	0.57	0.63	5249
1955	0.14	**74.37**	**16.82**	3.70	1.92	0.95	0.97	0.46	0.26	0.06	0.34	3489

of spring and autumn spawners similar to that present in the north-eastern area. The similarity between the age compositions of these stocks, and the age composition of the spawning concentrations fished from Fraserburgh, Peterhead, and Aberdeen in August and September, suggest also that a large part of the adult autumn-spawning stock on the Scottish east coast grounds is derived from pre-spawning concentrations further to the north and east.

The vertebral counts taken during the season, and the results of the analysis of otolith characters indicate that few of the spring spawners present in the north-eastern North Sea in the spring months, and which later appear on the Shetland grounds, penetrate as far south as the Fraserburgh-Peterhead fishing area. Almost all of the fish on these grounds, older than two years, belonged to the North Sea autumn-spawning group (spawning between July and January).

As in previous years, however, the recruit brood on these grounds was composed of a mixture of autumn and spring-spawned fish. The "spring" component was less prominent than in 1954 (Ann. Biol., Vol. XI) and constituted less than 10% of the total number sampled in May and June, and less than 1% in July, August, and September.

The high average length for age, which has been a feature of the fish caught in the north-western North Sea in recent years, was maintained in 1955. This is illustrated by the data contained in Table 21 which gives the mean lengths of fish with two to five winter-rings, sampled at Fraserburgh and Peterhead, and subdivided according to maturity stages for the pre-war years 1935 and 1938 and the post-war years 1947 and 1949—1955.

These data show that, except for the two-ringed fish, the mean lengths of all maturity stages of each age-group have increased since the war, and the increase has been most marked since 1950. This phenomenon has also been recorded in other parts of the North Sea (ANCELLIN: Ann. Biol., Vol. IX). The mean values in 1954 were approximately 2 cm. greater than in the pre-war years. The mean lengths of the two-year-old age-group do not reveal the same marked increase, but show considerable variability from year to year. This suggests that the greater part of the increase in length of the older age-groups is due to faster growth in the open sea adult phase of the life history, after the fish leave the nursery areas. The fact that no increase was observed in the mean lengths of one-ringed herring in the Moray Firth and Firth of Forth nursery areas also supports this explanation.

Fladen and Gut

Samples were taken in September and October 1955 from landings of Swedish trawlers at Aberdeen from the Fladen and Gut grounds. The data obtained from these samples have not yet been analysed in detail, but the length, maturity and Vert. S. distributions indicate that the stocks fished in these areas were composed principally of the older members of the North Sea autumn-spawning group in maturity stages V, VI, and VII.

Table 20. Percentage Age Composition of Fraserburgh and Peterhead Samples in August and September, 1950—1955

Year	Age (winter-rings) 1	2	3	4	5	6	7	8	9	10	>10	Number of fish
1950	0.16	**21.13**	**11.11**	7.59	10.88	8.84	10.80	20.11	4.15	3.91	1.33	1278
1951	1.62	**9.16**	**20.64**	15.23	6.08	10.93	9.47	12.55	8.56	3.47	2.29	2673
1952	—	**19.60**	**10.67**	17.91	10.25	3.69	6.88	6.43	8.84	7.57	8.16	2194
1953	0.96	**23.49**	**26.88**	6.83	12.03	6.61	2.48	5.14	3.84	5.36	6.38	1771
1954	0.70	**19.66**	**18.01**	22.94	5.90	9.57	5.16	2.50	3.40	4.22	7.93	2559
1955	—	**33.10**	**18.41**	12.51	14.04	4.25	5.45	3.48	1.12	2.60	5.25	1695

Table 21. Mean Lengths of Different Maturity Stages of 2- to 5-year-old Herring, Fraserburgh and Peterhead Samples, 1935—55

Year \ Maturity stage	2-ringed fish				3-ringed fish				4-ringed fish				5-ringed fish			
	I & VII-II	II	III-V	VI & VII	I– VII-II	II	III-V	VI & VII	I– VII-II	II	III-V	VI & VII	I & VII-II	II	III-V	VI & VII
1935	23.73	23.81	(24.60)	25.13	23.13	24.00	25.27	26.40	(24.46)	25.16	26.35	(27.65)	(25.10)	25.39	26.71	(27.62)
1938	22.78	(23.65)	24.14	—	23.95	24.69	25.78	—	(25.77)	25.94	26.40	—	26.43	26.88	27.34	-
1947	24.78	(24.23)	(24.98)	—	(23.68)	25.01	25.66	—	(25.77)	25.87	26.74	(27.38)	—	26.34	27.80	(28.14)
1949	22.85	23.64	23.96	—	24.46	24.92	(25.80)	—	(26.00)	26.15	27.03	—	(26.67)	(26.77)	(27.31)	-
1950	23.89	24.28	25.10	—	24.44	24.76	25.77	-	26.00	25.76	26.75	—	(27.74)	26.88	28.15	-
1951	23.89	24.70	25.26	(25.71)	24.97	25.54	26.54	26.38	25.52	25.86	26.84	26.24	26.14	26.61	27.66	(26.56)
1952	24.55	24.67	25.67	25.99	25.71	25.85	26.99	26.96	26.47	26.59	27.79	28.01	26.73	26.82	27.87	27.63
1953	24.03	24.51	25.40	25.75	25.28	25.72	27.08	26.93	26.11	26.61	27.99	27.76	27.49	27.42	28.89	28.21
1954	24.34	24.62	25.63	26.02	26.22	26.28	27.60	27.45	27.72	27.38	28.44	28.48	28.03	27.79	29.27	28.96
1955	23.85	23.61	25.17	25.67	26.07	25.88	27.45	27.67	28.29	27.58	28.92	28.95	29.10	28.85	29.58	29.30

Figures in brackets derived from samples of less than 50 fish.

B. West Coast

Minch

Drift-net and ring-net fisheries were conducted throughout the year over the customary grounds in the North and South Minch. The landing statistics for 1955 together with those for the three previous years are given in Table 22, p. 184.

The total effort and yield from the North Minch was considerably lower in 1955 than in the previous years, but in the South Minch the fishery was maintained at about the same level. The smaller North Minch landings were due mainly to a marked decline in the stock of large spring-spawning herring off the north-west mainland coast, which are fished in February and March, and to a reduction in the abundance of herring over the North Minch as a whole in the summer and early autumn.

Length and age data of the samples taken from the North and South Minch catches are given in Figures 21 and 22, and the maturity and Vert. S. data are given in Tables 23 and 24. The North Minch data are from drift-net catches and the South Minch data are from drift-net catches in February, March, November, and December, and from ring-net catches in January and May.

Table 23. Maturity and Racial Characters—North Minch—1955

A. Percentage Maturity (all age-groups)

Maturity stage	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
I	2.91	2.80	3.71	5.33	14.67	8.31	7.62	8.73	**23.25**	**42.26**	**41.67**	12.00
II	5.46	1.60	3.71	1.33	25.33	**47.85**	**42.89**	17.27	18.75	6.74	4.29	2.33
III	8.91	13.00	2.86	0.67	—	2.87	21.84	**24.91**	4.00	1.64	1.77	2.67
IV	7.82	17.20	7.71	—	—	1.43	14.23	25.09	8.00	0.91	1.77	3.00
V	0.91	5.20	2.00	—	—	0.86	9.82	11.45	2.25	—	0.51	1.00
VI	—	2.80	3.14	—	—	—	0.80	10.00	8.00	1.09	0.76	—
VII & VII–II	**74.00**	**57.40**	**76.85**	**92.67**	**60.00**	**38.68**	2.81	2.54	**35.75**	**47.36**	**49.25**	**79.00**
Number	550	500	350	150	150	349	499	550	400	549	396	300

B. Mean Vert. S. for each Maturity Stage (all age-groups)
(Nos. in brackets are No. of fish)

I	56.57	56.23	56.77	57.00	56.41	56.86	56.78	56.87	56.79	56.81	56.92	57.00
	(14)	(13)	(13)	(8)	(22)	(29)	(37)	(47)	(93)	(230)	(161)	(34)
II	57.12	57.00	56.92	56.50	56.46	56.54	56.68	56.60	56.84	56.84	57.12	56.43
	(17)	(8)	(12)	(2)	(37)	(166)	(208)	(95)	(75)	(37)	(17)	(7)
III	57.12	57.03	56.64	57.00	—	56.30	56.39	56.52	56.94	57.00	56.71	56.38
	(48)	(64)	(11)	(1)		(10)	(109)	(137)	(16)	(9)	(7)	(8)
IV	57.09	57.09	56.93	—	—	56.20	56.42	56.32	56.48	56.80	56.71	56.22
	(54)	(86)	(27)			(5)	(71)	(136)	(31)	(5)	(7)	(9)
V	56.71	57.12	57.29	—	—	56.33	56.41	56.62	56.89	—	57.00	56.33
	(7)	(26)	(7)			(3)	(49)	(61)	(9)		(2)	(3)
VI	57.00	56.71	56.91	—	—	—	57.00	56.48	56.57	56.20	57.00	—
	(1)	(14)	(11)				(4)	(54)	(30)	(5)	(3)	
VII & VII–II	56.49	56.39	56.56	56.49	56.49	56.59	56.79	56.71	56.41	56.38	56.51	56.53
	(401)	(283)	(266)	(138)	(88)	(132)	(14)	(14)	(112)	(256)	(194)	(229)
Overall mean	56.63	56.65	56.64	56.52	56.47	56.57	56.57	56.53	56.62	56.65	56.60	56.57

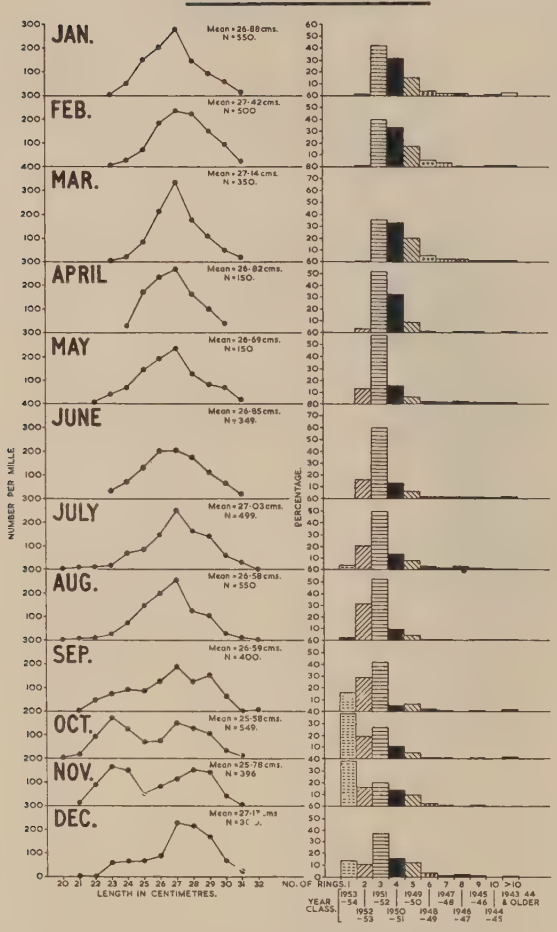


Figure 21. Length and age compositions of North Minch drift-net samples. January—December 1955. (Length frequencies unsmoothed).

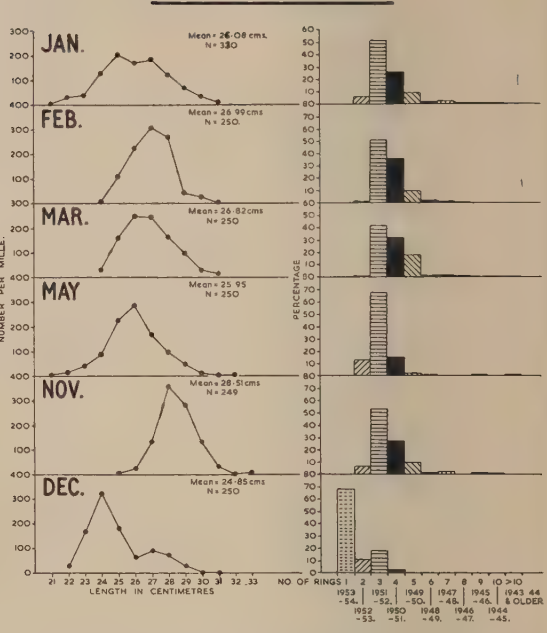


Figure 22. Length and age compositions of South Minch drift-net and ring-net samples. January and May (ring-net); February, March, November, December (drift-net) 1955. (Length frequencies unsmoothed).

Table 22. West Coast Herring Landings, 1952—55

	North Minch			South Minch		
	Landings (crans)	No. of arrivals	Landings per arrival (crans)	Landings (crans)	No. of arrivals	Landings per arrival (crans)
Drift-Net						
1952	149,456	8,526	17.5	23,255	796	29.2
1953	181,254	8,030	22.6	15,915	442	36.0
1954	183,951	7,928	23.2	17,128	455	37.6
1955	79,557	4,710	16.9	21,605	633	34.1
Ring-Net						
1952	20,195	904	22.4	32,717	1,159	28.1
1953	23,508	1,074	21.9	52,451	1,069	49.1
1954	37,488	1,142	32.8	68,629	1,568	43.1
1955	34,781	875	39.7	55,241	1,201	46.0

Table 24. Maturity and Racial Characters South Minch—1955

A. Percentage Maturity (all age-groups)

Maturity stage	Jan.	Feb.	Mar.	May	Nov.	Dec.
I	12.00	—	11.20	17.60	0.80	**63.60**
II	9.33	3.60	5.60	5.20	1.20	9.60
III	3.33	8.80	0.40	—	6.43	2.00
IV	5.33	13.20	0.40	—	2.01	—
V	—	1.20	—	—	—	—
VI	—	2.00	—	—	5.22	0.80
VII & VII—II	**70.00**	**71.20**	**82.40**	**77.20**	**84.34**	24.00
Number	150	250	250	250	249	250

B. Mean Vert. S. for each Maturity Stage (all age groups)
(Nos. in brackets are No. of fish)

I	56.50 (18)	—	56.46 (28)	56.49 (43)	57.00 (2)	56.94 (159)
II	56.50 (14)	57.00 (9)	56.79 (14)	56.77 (13)	56.67 (3)	56.92 (24)
III	57.00 (5)	57.00 (22)	57.00 (1)	—	56.75 (16)	56.80 (5)
IV	57.00 (8)	56.91 (33)	57.00 (1)	—	57.20 (5)	—
V	—	57.33 (3)	—	—	—	—
VI	—	56.80 (5)	—	—	56.92 (13)	—
VII & VII—II	56.61 (105)	56.49 (176)	56.59 (205)	56.51 (188)	56.50 (208)	56.40 (57)
Overall mean	56.62	56.63	56.59	56.52	56.57	56.81

The age compositions of the stocks in the two parts of the Minch show a much smaller proportion of the two-ringed recruit age-group than in the two previous years (Ann. Biol., Vols. X and XI). The relative failure of this brood was reponsible to some extent for the poor fishery in the North Minch in the summer months.

One-ringed herring appeared in the catches in large numbers in the samples taken in the period September—December, which points to higher recruitment of two-ringed herring to the 1956 stocks.

The "racial" data indicated that the main body of the North and South Minch stocks in 1955 was composed of autumn-spawning herring.

C. Tagging

In 1955 tagging was conducted from commercial fishing vessels in the usual manner, with Scottish and Lea tags and with toggle and one-man bridle attachments. Liberations were made in the following localities:—

Area	Period	Number of liberations by type	
Upper Moray Firth ("Halflin" stock)	February and March	1327	Lea 669; Scottish 658
Scottish north-east coast	June and July	3874	Lea 2305; Scottish 1569
Fladen and Gut	September	528	All Lea tags
	Total	5729	Lea 3502; Scottish 2227

Recaptures up to 20. March 1956 totalled 116, of which 77 were Lea tags and 39 Scottish tags. Details of the regions in which the recaptures were made are shown in Table 25.

Table 25

Upper Moray Firth liberations

Area of recapture	Lea	Scottish
Upper Moray Firth ...	18 (0—25)	6 (7—37)
Scottish north-east coast	1 (127)	1 (145)
Total	19	7
Percentage of liberations	2.8	1.1

North-east coast liberations

Area of recapture		
Scottish north-east coast	17 (0—46)	7 (1—63)
Fladen	30 (0—70)	18 (1—54)
Gut	3 (25—80)	—
Dogger	2 (78—129)	1 (51)
Skagerak	—	2 (221—265)
Unknown	5	4
Total	57	32
Percentage of liberations	2.5	2.0

Fladen and Gut liberations

Area of recapture	
Unknown	1

(Figures in brackets refer to number of days between liberation and recapture.)

These results show the same general pattern of recaptures as in previous years. Further evidence of the importance of the upper Moray Firth nursery area as a recruitment centre for the north-western North Sea adult stock is given by the recaptures from the "halflin" tagging experiments.

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Survey of the German Commercial Herring Fisheries and the Biological Conditions of the Stocks

(Figures 23–26 and Tables 26–35)

A. The Fishing

In Table 26 the total herring landings of the German fishing fleet are recorded. There are three types of fishing vessels, herring trawlers, drifters, and cutters. It is obvious that the paramount part of the landings (81.8%) came from the North Sea.

Table 26. Total Landings in 1955 in Thousand Tons

	North Sea		Channel		Other areas[1])		Total	
	1955	1954	1955	1954	1955	1954	1955	1954
Trawlers ..	156	146	34	47	2	—	192	193
Drifters ...	62.4	57.9	5.8	2.7	—	—	68.2	60.6
(Logger)								
Cutters ...	55	40	—	—	19	19	74	59
Total	273.4	243.9	39.8	49.7	21	19	334.2	312.6

[1]) Baltic Sea, Kattegat/Skagerak.

1. Herring trawlers

There are three seasons, in the N. North Sea during spring, all over the North Sea during summer and autumn, and in the English Channel during autumn and winter.

a) The spring fishery is concentrated on the Viking Bank, in the Utsire region and there is also some fishing on the Otter Bank and round the Shetlands from February to May. In Table 27 a survey of this fishing in 1955 is given (see also Figure 23).

The total landings of this season amounted to 5042 tons of herring, 3406 tons of it being caught on the Viking Bank and 1636 tons at Utsire. 71 trips were made during the season as compared with 59 in 1954. To the Viking Bank 50 trips were made as in the previous year and 21 to Utsire (12 more than in 1954). The total yield increased from 3654 to 5042 tons (27.53%) as the result of increased effort.

Table 27. Herring Trawler Fishery 1955. Catch per Day's Fishing and Total Landings in Tons

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	1954
North Sea														
Viking Bank ("Ostkante")														
Number of trips	—	7	11	23	9	—	—	—	—	—	—	—	50	50
Fishing days	—	68	110	223	83	—	—	—	—	—	—	—	484	459
Catch per day's fishing.	—	6.5	4.8	7.5	7.1	—	—	—	—	—	—	—	6.7	6.0
Utsire														
Number of trips	—	5	5	8	3	—	—	—	—	—	—	2	23	9
Fishing days	—	49	40	80	25	—	—	—	—	—	—	13	207	80
Catch per day's fishing.	—	5.0	—	—	—	—	—	—	—	—	—	4.2	4.8	10.5
Fladen														
Number of trips	—	—	—	—	—	11	175	294	207	2	—	—	689	364
Fishing days	—	—	—	—	—	89	1499	2367	1771	17	—	—	5743	3297
Catch per day's fishing.	—	—	—	—	—	9.8	16.2	20.8	19.1	5.8	—	—	18.8	15.0
Gut														
Number of trips	—	—	—	—	—	—	—	8	28	22	14	—	72	74
Fishing days	—	—	—	—	—	—	—	46	236	146	134	—	562	627
Catch per day's fishing.	—	—	—	—	—	—	—	19.8	19.4	15.7	12.4	—	14.1	18.7
Dogger Bank														
Number of trips	—	—	—	—	—	—	—	—	49	222	29	—	300	532
Fishing days	—	—	—	—	—	—	—	—	399	2013	257	—	2669	4559
Catch per day's fishing.	—	—	—	—	—	—	—	—	19.8	13.5	13.0	—	14.6	16.5
Total North Sea														
Number of trips	—	12	16	31	12	11	175	302	284	246	43	2	1134	1029
Days per trip	—	14.8	15.3	15.2	13.8	13.1	12.3	11.9	12.1	12.4	12.9	10.0	12.3	12.4
Fishing days per trip	—	9.8	9.9	9.8	9.0	8.1	8.5	8.0	8.5	8.8	9.1	5.0	8.5	8.8
Total herring landings	—	872	917	2385	868	884	23482	50320	42505	28996	4678	53	155960	144241
Catch per day's fishing.	—	7.2	5.4	7.9	8.0	9.8	16.1	20.8	17.7	13.3	12.1	4.2	16.2	16.0
Channel														
Sandettié														
Number of trips	—	—	—	—	—	—	—	—	—	—	133	3	136	187
Fishing days	—	—	—	—	—	—	—	—	—	—	1194	26	1220	1711
Catch per days' fishing.	—	—	—	—	—	—	—	—	—	—	15.2	4.8	15.0	13.7
Dieppe														
Number of trips	—	—	—	—	—	—	—	—	—	—	1	44	45	114
Fishing days	—	—	—	—	—	—	—	—	—	—	3	412	415	929
Catch per day's fishing.	—	—	—	—	—	—	—	—	—	—	76.0	15.5	16.1	12.5
Boulogne														
Number of trips	—	—	—	—	—	—	—	—	—	—	12	72	84	86
Fishing days	—	—	—	—	—	—	—	—	—	—	119	663	782	706
Catch per day's fishing.	—	—	—	—	—	—	—	—	—	—	14.0	9.8	10.6	20.7
Total Channel														
Number of trips	—	—	—	—	—	—	—	—	—	—	146	119	265	388
Days per trip	—	—	—	—	—	—	—	—	—	—	13.2	14.1	13.6	13.2
Fishing days per trip	—	—	—	—	—	—	—	—	—	—	9.0	9.3	9.1	8.6
Total herring landings	—	—	—	—	—	—	—	—	—	—	19470	14280	33750	47008
Catch per day's fishing.	—	—	—	—	—	—	—	—	—	—	14.9	12.9	14.0	14.0

The catch per day's fishing (5.8 tons) was 30.13% lower than in the previous season. In the Viking Bank area there was a slight increase, from 6.0 to 6.7 tons, while at Utsire the catch per day decreased from 10.5 to 4.8 tons.

b) Summer/autumn fishery. During this season the trawlers frequented the Bressay/Fladen area, the Gut and the Dogger Bank area during the period June to November.

The fishery started about mid-June on the Fladen and was carried out for 100 days until the beginning of October (84 in 1954). The trawlers made 689 trips (1954 = 364) and the total yield was 104,951 tons or over 100% more than in 1954 (50,031 tons). The catch per day's fishing increased from 15.0 to 18.8 tons (Table 27).

The fishing on the Gut took place from the end of July until October and lasted 70 days (40 in 1954). 72 trips were made (74 in 1954). The total yield dropped from 11,466 tons (1954) to 8,495 tons (about 25.91%), also the catch per day's fishing showed a decline from 18.7 to 14.1 tons (Table 27).

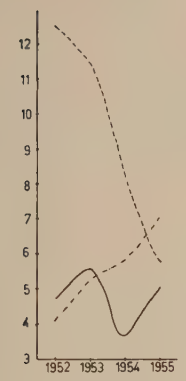


Figure 23. Spring fishery 1952—1955.
——— Total landings in 1000 tons
····· Catch per day in tons
–.–.–. Number of trips × 10

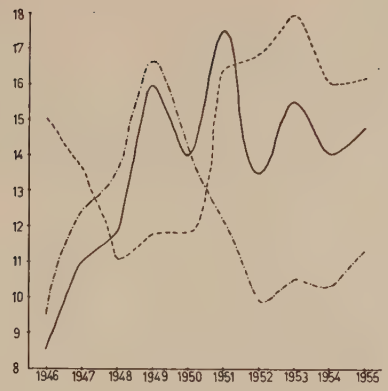


Figure 24. Trawl fishery (summer/autumn) 1946—1955.
——— Total landings in 1000 tons
····· Catch per day in tons
–.–.–. Number of trips × 100

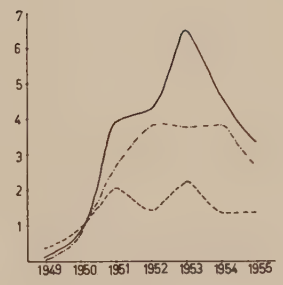


Figure 25. Fishery in the Channel 1949—1955.
——— Total landings in 1000 tons
·· Catch per day in tons × 10
–.–.–. Number of trips × 100

In the Dogger Bank area the fishery began in September and was continued until November (63 days as against 87). 300 trips were made as against 532 in 1954. The total yield in this area decreased from 79,087 to 37,417 tons (about 52.69%), and also the catch per day showed a decline from 16.5 to 14.6 tons (Table 27).

The yield of German herring trawl fishery in the season 1955 in the North Sea has increased from 144,000 to 156,000 tons, the number of trips from 1,029 to 1,134 and the catch per day from 16 to 16.2 tons. This rise is mostly due to the long and favourable fishing period on the Fladen (Table 27). Figure 24 shows the development during the last ten years.

c) The Channel fishery. The season takes place from November to January; but in 1955 the fishing came to an end in December.

Altogether 265 trips were made, as against 388 in 1954. The total yield was 33,750 tons (47,008 tons). The catch per day was the same as in 1954, 14.0 tons (Table 27). Figure 25 shows the details.

In November the main catch came from Sandettié, in December from Dieppe/Boulogne. In the Sandettié area the catch per day amounted to 15.0 tons (13.7 tons), at Dieppe 16.1 tons (12.5 tons) and off Boulogne 10.6 tons (20.7 tons).

2. Drifters

In order to market "fresh herring" a part of the German drifters have, for some years now, operated at Utsire, and occasionally in other areas of the North Sea, during March—June. From June to November the fishing takes place on the conventional North Sea grounds. In November—December the drifters go to the Channel, where they operate mainly with drift-nets but partly also with trawls. In 1955 about 15% of the "fresh herring" catches came from trawlers; in the summer/autumn fishing the proportion was about 24%.

a) Fresh herring fishery. 86 trips were made in 1955 as against 73 in 1954. The total yield was 3,544 tons (2,949 tons) and the catch per day's fishing 4.6 tons (4.5).

b) Salt herring fishery in the North Sea. The total yield has slightly declined from 59,710 tons to 58,814 tons, but also the number of trips was smaller, namely 606 as against 636 in 1954. The catch per day, however, was 4.4 tons (4.3 tons). A detailed survey of the 1955 season is given in Table 28. It may be noted that the season lasted longest on the northern grounds (Fladen, Gut and, Long Forties). The number of fishing days increased from 1,624 (1954) to 2,436 on the Fladen Ground, the corresponding increase being from 1,768 to 4,102 for the Gut/Long Forties. Great increase in the total yields was also noted both for the Fladen Ground (3,972—15,409 tons) and for the Gut/Long Forties (6,737—20,795 tons). Finally, the catch per day showed an increase from 2.2—6.2 tons (drift-nets) and from 5.6—7.5 tons (drifter/trawlers) on the Fladen Ground, the corresponding figures for the Gut/Long Forties being 3.4—3.2 (drifters) and 7.8—6.3 (trawlers). Here, consequently, a decline

Table 28. Drifter Herring Fishery 1955. Catch per Day's Fishing and Total Landings in Tons

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	1954
Total North Sea														
Number of trips	—	—	1	27	39	106	124	97	96	95	106	1	692	709
Travel days per trip ..	—	—	15.0	14.6	13.0	22.0	20.8	27.0	27.8	25.6	29.8	47.0	24.2	23.9
Fishing days per trip ..	—	—	10.0	9.9	8.6	16.9	16.0	22.7	23.9	21.6	24.0	37.0	19.5	19.1
Total landings	—	—	15	722	1972	9201	13054	10436	10517	8233	8178	75	62358	57920
Catch per day's fishing.	—	—	1.5	2.7	5.8	5.1	6.6	4.7	4.6	4.0	3.2	2.0	4.6	4.3
Fishing Grounds														
Viking Bank and Utsire														
Total landings	—	—	29	264	1730	3924	—	—	—	—	—	—	5947	4025
Fishing days	—	—	43	100	240	902	—	—	—	—	—	—	1285	1209
Catch per day's fishing.	—	—	0.5	4.0	7.6	4.5	—	—	—	—	—	—	5.0	3.6
			(0.8)	(1.3)	(1.7)	(3.3)	—	—	—	—	—	—	(1.3)	(1.6)
Ling Bank														
Total landings	—	—	—	41	213	334	20	0	2	—	—	—	610	377
Fishing days	—	—	—	16	30	64	3	1	2	—	—	—	116	107
Catch per day's fishing.	—	—	—	2.1	7.6	5.5	6.3	0	0.9	—	—	—	5.7	3.8
	—	—	—	(3.1)	(1.5)	(2.4)	—	—	—	—	—	—	(2.8)	—
Bressay and Shetlands														
Total landings	—	—	18	—	60	1376	27	—	—	—	—	—	1481	757
Fishing days	—	—	8	—	15	373	3	—	—	—	—	—	399	391
Catch per day's fishing.	—	—	2.1	—	4.4	3.7	—	—	—	—	—	—	3.8	2.1
	—	—	(2.3)	—	(0.1)	(0.9)	(8.8)	—	—	—	—	—	(0.5)	(1.0)
Fladen														
Total landings	—	—	40	143	115	4412	8684	1857	158	—	—	—	15409	3972
Fishing days	—	—	28	18	43	656	1410	259	22	—	—	—	2436	1624
Catch per day's fishing.	—	—	0.8	7.8	2.9	7.1	6.1	4.5	9.6	—	—	—	6.2	2.2
	—	—	(2.7)	(8.3)	(0.2)	(2.5)	(7.4)	(8.9)	(7.1)	—	—	—	(7.5)	(5.6)
Gut and Long Forties														
Total landings	—	—	19	124	180	1252	4717	8743	4234	842	684	—	20795	6737
Fishing days	—	—	11	33	33	195	793	2108	685	121	123	—	4102	1768
Catch per day's fishing.	—	—	0.1	3.8	5.8	6.8	6.0	3.5	4.7	5.1	4.6	—	3.2	3.4
	—	—	(3.0)	(4.0)	(0.1)	(1.0)	(8.3)	(7.6)	(7.9)	(7.4)	(5.6)	—	(6.3)	(7.8)
Dogger Bank														
Total landings	—	—	—	7	0	—	6	366	6909	2790	311	—	10389	26586
Fishing days	—	—	—	2	1	—	17	154	1599	962	50	—	2785	5557
Catch per day's fishing.	—	—	—	1.3	0	—	0.4	1.6	4.0	2.2	0.2	—	3.1	4.9
	—	—	—	(5.4)	—	—	—	(6.1)	(6.8)	(5.8)	(6.6)	—	(6.1)	(8.1)
"Binnensee"														
Total landings	—	—	—	—	—	—	—	—	—	5325	2755	—	8080	15644
Fishing days	—	—	—	—	—	—	—	—	—	1016	1380	—	2396	2854
Catch per day's fishing.	—	—	—	—	—	—	—	—	—	5.6	2.1	—	3.5	5.9
	—	—	—	—	—	—	—	—	—	—	—	—	—	(0.3)
Channel														
Total landings	—	—	—	—	—	—	—	—	—	—	2143	3674	5817	2657
Fishing days	—	—	—	—	—	—	—	—	—	—	631	1189	1820	875
Catch per day's fishing.	—	—	—	—	—	—	—	—	—	—	3.9	3.4	3.6	2.8
	—	—	—	—	—	—	—	—	—	—	(1.0)	(5.0)	(4.8)	(5.5)

( ) Trawl catches.

could be noted. The grounds (Dogger Bank—"Binnensee") showed a strong decline both in the number of fishing days, the total yields and the yield per effort.

c) Channel fishery. The number of trips was 96 as against 54 in 1954. The total yield increased from 2,657 to 5,817 tons, and the number of fishing days from 875 to 1,820. The catch per day was 3.6 tons against 2.8 tons for the drift-netters and 4.8 tons instead of 5.5 tons for the trawlers.

3. Cutters

The information available appears from Table 29. The fishing is carried out for marketing and for industrial purposes as well in the open sea as in coastal waters. During winter the fishing is concentrated in the German Bight and in summer in the open North Sea, by means of the trawl. During midsummer some vessels fish for young herring by means of the trawl and the pair trawl. The total output of this fishery increased from 627 (1954)

Table 29. Total Landings of Herring from Cutters in 1955 (Tons)

	Consumption	Factories	Total
January	—	66	66
February	294	527	821
March	107	4,042	4,149
April	23	69	92
May	4	20	24
June	6	849	855
July	10	11,115	11,125
August	218	20,308	20,526
September	451	13,775	14,226
October	361	2,871	3,232
November	60	43	103
December	3	75	78
Total 1955	1,537	53,760	55,297
Total 1954	627	39,361	39,988

to 1,537 tons of herring for human consumption and from 39,361 to 53,760 tons for industrial purposes.

B. The Herring Stock

The material investigated consists of 72 samples comprising 11,755 fish and the main results are concentrated in Tables 30—35.

1. Viking Bank/Utsire Area

In this area 17 samples containing 3,472 herrings were examined. 12 samples came from the trawl fishery and 5 from the drift-nets.

The average length of the herring in the different months was 29.68—28.71 cm. (trawl) and 28.74 to 26.15 cm. (drift-nets), the weight being 160 to 139 g. (trawl) and 162 g. (drift-nets) (Table 30). It appears from Table 32 that in February the maturity stage V was largely predominant in the trawl catches, whereas stage II was most frequent in March and April. In the drift-net catches stage II was predominant in May and June. The fat content increased slightly from month to month (Table 35). The composition of the catches, as to age, indicates that the 3- and 4-year-old

Table 30. Length Composition of all Samples (‰)

	Trawl			Drift-nets		Trawl				Trawl			Trawl			Trawl and Drift-nets				Young Herring east of Dogger Bank	
	Viking Bank Utsire Area			Utsire Area		Fladen Ground				Gut			Dogger Bank			Sandettié- N. Hinder		Channel			
	II	III	IV	V	VI	VI	VII	VIII	IX	VIII	X	XI	VIII	IX	X	XI[1]	X[2]	XII[1]	XII[2]	VII	VIII
h, cm. 38	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
37	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
36	6	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
35	12	9	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	-	—	—
34	14	5	10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
33	16	14	5	—	—	7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
32	54	41	32	30	—	—	1	2	10	6	—	—	3	—	—	—	—	—	—	—	—
31	134	143	76	43	3	4	5	14	65	44	10	—	19	16	10	—	—	—	—	—	—
30	180	**220**	**203**	150	38	32	26	98	105	135	50	70	83	103	65	5	—	—	—	—	—
29	**210**	154	173	203	78	102	92	**204**	165	**169**	125	**210**	110	**261**	150	25	20	72	—	—	—
28	166	152	171	**313**	122	112	121	188	**220**	102	165	200	154	249	165	130	122	**232**	40	—	—
27	136	162	120	133	**132**	154	139	126	115	119	**240**	120	174	126	125	140	**246**	186	**190**	—	—
26	46	58	60	47	116	133	139	120	**150**	140	195	140	**191**	65	**200**	170	204	180	170	—	3
25	12	21	51	40	145	144	**197**	**129**	95	**168**	140	**160**	172	78	165	**225**	173	119	**250**	—	—
24	6	12	61	30	**205**	**151**	132	85	55	94	30	90	63	58	75	170	143	93	210	3	—
23	2	8	23	10	91	119	86	26	15	19	25	10	18	40	40	125	82	**103**	120	24	3
22	4	—	7	1	49	42	48	7	5	3	20	—	7	2	5	10	10	15	20	97	11
21	—	1	1	—	21	—	11	1	—	1	—	—	3	2	—	—	—	—	—	156	40
20	—	—	—	—	—	—	2	—	—	—	—	—	3	—	—	—	—	—	—	**212**	91
19	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	178	166
18	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	156	252
17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	118	**351**
16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	56	83
.....	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
er	500	656	1403	300	613	285	1492	2064	351	1964	200	100	671	446	200	200	98	197	200	372	373
ngth, cm.	29.68	29.41	28.71	28.74	26.15	26.41	26.30	27.68	28.09	27.68	27.34	27.56	27.35	28.06	27.26	26.00	26.30	26.07	25.07	19.86	18.53
eight, gr.	160	143	139	—	162	177	137	—	—	—	—	155	—	185	162	—	—	—	—	—	—
‰ ...	418	410	490	347	489	480	460	488	445	501	510	465	428	430	420	455	429	550	—	—	—

rawl. [2]) Drift-nets.

Table 31. Age Composition of all Samples (‰)

Locality / Gear	Age	Viking Bank Utsire Trawl	Utsire Drift-net	Fladen Ground Trawl	Gut Trawl	Dogger Bank Trawl	Sandettié/ North Hinder Trawl	Sandettié/ North Hinder Drift-net	Channel Trawl	Channel Drift-net	Young Herring east of the Dogger Bank
Year-class 1954	1	—	3	—	—	—	—	—	—	—	—
1953	2	52	99	5	—	9	—	—	—	—	**949**
1952	3	**336**	**455**	**463**	**383**	**471**	296	306	175	**397**	51
1951	4	218	230	255	171	186	**324**	**494**	**232**	265	—
1950	5	156	79	92	132	131	151	94	164	206	—
1949	6	52	45	62	130	94	67	35	209	63	—
1948	7	43	45	57	63	41	84	35	102	11	—
1947	8	71	10	16	56	36	50	24	73	32	—
1946	9	37	10	28	28	21	11	—	40	21	—
1945	10	15	—	5	11	6	11	12	—	5	—
<1945	>10	20	24	17	26	5	6	—	5	—	—
Total		1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Number		601	292	596	538	467	179	85	177	199	367

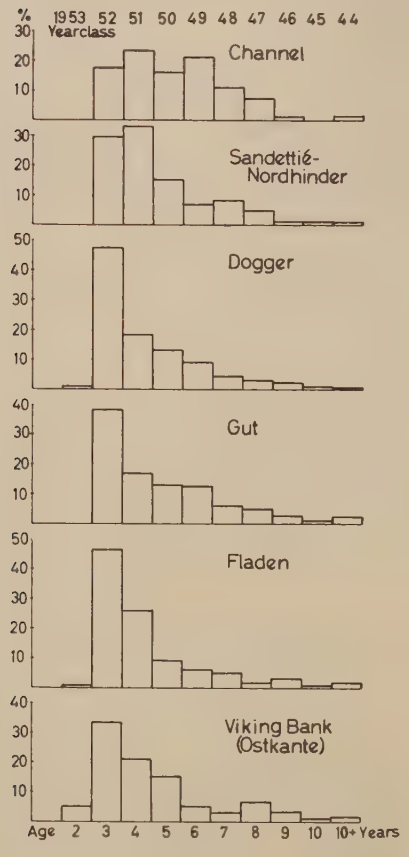


Figure 26. Age composition in 1955 (trawl).

fishes were predominant (see Figure 26). The sequence of the most important year-classes, as to their relative strength proved to be as follows: 1952 (336‰), 1951 (218‰), 1950 (156‰) (Table 31). The total number of vertebrae (VS) is given in Table 34. The average number was 56.75. The average number of the different stages of maturity shows a higher value for stages III—VI. This value indicate that the catches have been a mixture of different populations. The investigations of the gill rakers confirm this opinion. The catches consisted of large Atlantic and North Sea herrings (late winter spawners) and of autumn spawners.

2. Fladen Ground

From the Fladen area 15 samples containing 4,041 herrings from the trawl fishery were investigated.

The average length increased from 26.41 to 28.09 cm. from June to September (Table 30).

The maturity also advanced from June to September. Stages II and III were predominant in June and July, while stages IV and V occurred more frequently in August and September. In these months a large number of spent herring was also met with (Table 32).

The highest fat index (296) occurred in July (Table 35).

The age composition shows an outstanding number of 3-year-old fish (1952 year-class=463‰), the next most important year-class being that of 1951 (255‰) (Table 31).

The average number of vertebrae was 56.55 (Table 34). The herring in maturity stages I to II

Table 32. Sexual Maturity in all Samples (‰)

ear	Trawl			Drift-nets		Trawl				Trawl			Trawl			Trawl and Drift-nets				Young Herring east of Dogger Bank	
rea	Viking Bank Utsire Area			Utsire Area		Fladen Ground				Gut			Dogger Bank			Sandettié-N. Hinder		Channel			
onth	II	III	IV	V	VI	VI	VII	VIII	IX	VIII	X	XI	VIII	IX	X	XI[1])	X[2])	XII[1])	XII[2])	VII	VIII
ages																					
....	16	100	143	70	133	145	190	61	110	11	40	10	137	80	30	5	20	—	—	936	990
....	228	740	551	607	589	390	360	112	255	17	167	131	67	40	200	5	51	—	80	41	5
I....	2	—	—	50	201	320	340	112	145	56	10	10	92	80	15	—	—	—	—	18	5
V	56	—	—	—	11	115	80	237	155	210	51	—	252	100	—	—	92	—	—	5	—
.....	698	50	20	13	—	25	30	299	135	606	288	30	446	590	240	350	827	90	508	—	—
I	—	—	10	13	22	—	—	3	25	11	5	31	—	40	10	635	—	680	191	—	—
II ...	—	110	276	247	44	5	—	176	175	89	439	788	6	70	505	5	10	230	221	—	—
otal	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000

[1]) Trawl. [2]) Drift-nets.

Table 33. Total Number of Vertebrae (VS) (‰)

VS	Utsire V–VI	Fladen Ground VI–VIII	Gut VIII–X	Dogger Bank VIII–X	Sandettié-Hinder X–XI	Channel XII	Young Herring east of Dogger
59	—	—	—	2	2	—	—
58	128	58	56	36	51	15	63
57	**537**	**478**	**454**	452	**471**	350	**441**
56	303	425	**454**	**459**	451	**567**	398
55	31	37	34	44	25	68	91
54	—	2	2	7	—	—	7
53	1	—	—	—	—	—	—
Total	1000	1000	1000	1000	1000	1000	1000

Table 34. Average Number of Vertebrae in Relation to Stages of Maturity

Stages of Maturity	Utsire V–VI		Fladen Ground VI–VIII		Gut VIII–X		Dogger Bank X–XI		Sandettié-Hinder X–XI		Channel XII	
	Number	Aver.	Number	Aver.	Number	Aver.	Number	Aver.	Number	Aver.	Number	Aver.
I–II	83	56.86	102	56.72	18	56.67	45	56.49	1	56.00	—	—
II	414	56.78	190	56.72	40	56.70	59	56.27	99	56.62	16	56.88
III–VI	194	**57.04**	498	56.49	409	56.52	318	56.52	294	56.54	291	56.66
VII	16	56.57	27	56.41	116	56.47	54	56.41	1	56.00	79	56.71
VII–II	138	56.67	45	56.31	40	56.58	106	56.45	—	—	11	57.09
Total	845	56.75	862	56.55	623	56.53	582	56.47	395	56.55	397	56.69

Table 35. Quantity of Intestinal Fat

Locality	Month	Quantity 1	2	3	4	Number	Index
Viking Bank/Utsire Area	II	409	58	31	2	500	125
	III	38	43	13	6	100	187
	IV	40	41	13	—	94	161
Utsire Area	V	154	97	33	16	300	170
	VI	10	55	21	4	90	199
Fladen Ground	VI	8	65	23	4	100	223
	VII	2	21	52	24	99	296
	VIII	16	35	39	10	100	233
The Gut	VIII	200	59	31	10	300	150
	X	67	24	6	3	100	145
Dogger Bank	VIII	165	66	46	23	300	176
	X	131	52	16	1	200	144

had a markedly higher vertebral average than those in stages III to VII—II. Investigations of the gill rakers showed that the herring in the young maturity stages were mostly autumn spawners from the Scottish groups and late winter spawners.

The age composition of the Bressay Ground herring is in good accordance with that of the Fladen Ground stock.

3. Gut

15 samples totalling 2,264 herrings were examined.

The average lengths were between 27.34 and 27.68 cm. (Table 30).

The maturity changed from stages IV—V in August to stages V—VII in October. In November the spent herring were predominant.

The fat content in this area was moderate (Table 35).

The age composition showed resemblance to that of the Fladen, as the 3-year-old herrings were predominant. The sequence of the most important year-classes was the following: 1952 (383‰), 1951 (171‰), 1950 (132‰) and 1949 (130‰) (Table 31).

The average number of vertebrae was 56.53 (Table 34). The vertebral average of herrings in maturity stages I—II was somewhat higher than the average in stages III to VII/II. This was caused by the presence of some late winter spawners. The bulk consisted of autumn spawners probably from different groups.

4. Dogger Bank Area

From this area 8 samples, containing 1317 herrings, were investigated.

The average length in August and October was 27.35 and 27.26 cm. respectively, in September it was 28.06 cm. (Table 30).

Fish in maturity stages IV—V were dominant in August—September, while in October the spent herring formed the main bulk (Table 32).

The fat index was low.

The 3-year-old herring were predominant (1952 = 471‰), the next most important year-class being that of 1951 (186‰) (Table 31).

The average number of vertebrae was 56.47 (Table 34), and the main bulk of the stock was composed of autumn spawners from different groups. Some single individuals of the late winter-spawner type were observed in the catches.

5. Sandettié/North Hinder

Four samples from trawlers and one sample from a drifter comprising 498 herrings were investigated.

The average length of the drift-net herrings was in October 26.30 cm., while the trawl-caught herring measured 26.00 cm. in November (Table 30).

The majority of the drift-net herrings had reached maturity stage V in October and in November the herrings in this area were spawning (Table 32). Four-year-old fish were predominant in the trawl as well as in the drift-net catches. The most important year-classes caught by the trawl were the following: 1951 (394‰), 1952 (296‰), and 1950 (151‰) (Table 31).

Table 34 shows the average number of vertebrae (56.55) in relation to maturity.

The herring population in this area was probably composed of different groups of autumn spawners, and, according to meristic counts, herrings from the Dogger and the Downs were present.

6. The Channel

Two samples each from the trawlers and the drifters, comprising together 397 herrings, were investigated.

The average length of the trawl-caught fish was 26.7 cm. while those from the drift-nets measured 25.7 cm. (Table 30).

The maturity ranged from stage V to stage VII (Table 32). The drift-net catches were largely based on herrings of stage V, but the trawl catches on spawning fish (VI—VII). As regards the age, there was also a difference when the two gears were compared, as appears from Table 30. The 1951 year-class was most abundant in the trawl catches, while the 1952 year-class was predominant in those of the drifters. The most important year-classes caught by the trawl were those of 1951 (232‰), 1949 (209‰), 1952 (175‰), and 1950 (164‰); those of 1952 (397‰), 1951 (265‰), and 1950 (206‰) were the most important ones in the drift-net catches.

The average number of vertebrae was 56.69 (Table 34), and the herring belonged to the Channel group which is spawning in autumn and winter in this area.

7. Young herring east of the Dogger Bank

Nine samples containing 746 herrings were investigated.

The average length was 19.86 cm. in July and 18.53 cm. in August. More than 900‰ of these herrings were juvenile. The 1953 year-class was the most important one in the age composition (949‰). The average number of vertebrae was 56.46. The origin of the young herring cannot yet be established in detail. The bulk of the herring belonged presumably to the central North Sea

group, but fish from other regions were also observed.

Prospects

Judging from the frequency of the year-classes, we may assume that great concentrations of 4-year-old (1952) and partly also 5-year-old herrings (1951) will appear on the North Sea fishing grounds during the summer and autumn of 1956.

As regards the yield of the fishery on the different grounds in 1956 it is difficult to forecast anything definite at the moment. It will depend chiefly upon the 1953 year-class (3-year-old herring), which will attain first maturity in 1956, and upon the hydrographic conditions.

For the Channel it may be presumed that the concentrations will consist largely of herring belonging to the 1952 and 1951 year-classes (4- and 5-year-olds). If the 1953 year-class will be equally abundant as that of 1952 the fishing should be on the same level as in 1955.

K. SCHUBERT

The Conditions of the Herring Fishery in the Northern North Sea during August 1955

(Figures 27–30 and Tables 36–39)

During a cruise from 6. to 20. August 1955, the R/V "Anton Dohrn" was working on the Fladen Ground, Bressay Shoal, and the Gut in the North Sea to investigate the relation between the distribution of the herring stocks, the activity of the trawlers, and the hydrographical conditions.

The material comprises 44 samples containing 8087 herrings. Figure 27 shows the positions of the stations, the numbers of which are referred to in Tables 36 and 37. As is shown in Table 36 the average length varied from 25.97 to 29.84 cm. The relative number of herring at different stages of maturity also appears in the table.

Taking all the areas together, the bulk of the herrings were full, and the majority of spent herrings occurred on the Fladen Ground. The most advanced stages of maturity were found on the southern Fladen and near the Turbot Bank. On the Fladen spent herrings appeared in greater number after 15. August 1955 (Table 36a).

In Table 36a the material from Table 36 is summarized, for the most important fishing areas.

The age composition in the different samples and areas is shown in Tables 37 and 37 a. It appears that the 3-year-old herrings were predominant in all areas, especially on the grounds near Bressay Shoal and on the Gut. The sequence of the most

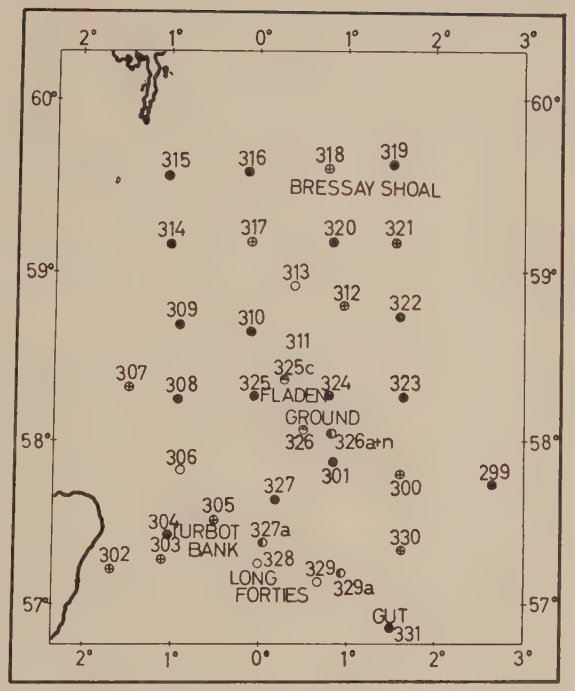


Figure 27. Chart showing positions of stations.

Table 36. Average Length, Races (%), and Maturity Stages (‰)

Stat. Nos.	Length, cm.	Races (%) Winter Spawners	Sum. + Autumn Spawners	Uncertain	Maturity Stages (‰) I-III	IV-VI	VII
315	27.22	1	99	—	9	91	—
316	29.84	—	—	—	—	—	—
317	—	—	—	—	41	56	3
320	27.15	24	76	—	—	—	—
309	27.73	—	—	—	—	—	—
310	28.25	—	—	—	—	—	—
322	26.64	1	99	—	34	64	2
311	28.00	—	—	—	—	—	—
308	25.97	15	80	5	51	48	1
325	28.51	5	93	2	15	68	17
325c	28.30	—	—	—	—	—	—
324	28.82	—	—	—	—	—	—
323	—	—	—	—	28	37	35
326	27.92	—	—	—	16	40	44
326a	28.50	4	93	3	—	—	—
326n	28.50	13	86	1	—	—	—
301	27.06	15	84	1	36	56	8
304	29.68	—	100	—	1	99	—
327a	28.90	—	—	—	2	86	12
329a	27.55	—	—	—	2	88	10
331	27.02	6	93	1	26	71	3

Table 36a. Stages of Maturity (‰) as to Areas

	Bressay Shoal	Fladen Ground	Gut and Long Forties
Stages I	10	61	10
II	175	111	17
III	65	112	58
IV	320	237	210
V	410	299	605
VI	5	3	11
VII	15	177	89
Total	1000	1000	1000
Number	200	689	600

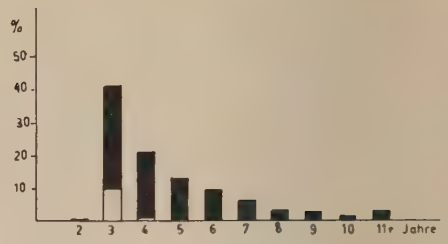


Figure 28. Age composition of the different stocks on the Fladen Ground, August 1955.
Black column = autumn spawners
White column = late winter spawners

Table 37. Age Composition of Herrings in different Localities (%)

Year-class	Age	Station Numbers 315	320	322	325	308	323	301	304	331
1953	2	—	—	7	—	—	—	—	—	—
1952	3	49	55	53	20	70	36	34	8	58
1951	4	24	20	13	28	22	32	13	15	14
1950	5	14	8	10	16	—	12	21	23	9
1949	6	7	6	7	8	1	12	13	20	7
1948	7	4	1	3	17	5	4	6	4	4
1947	8	1	4	7	1	—	2	1	11	6
1946	9	—	5	—	8	—	—	6	3	1
1945	10	—	1	—	1	1	—	—	1	1
<1945	>10	1	—	—	1	1	2	6	15	—
Total		100	100	100	100	100	100	100	100	100

Table 37a. Age Composition as to Areas (‰)

Year-class	Age	Areas Bressay Shoal	Fladen Ground	Gut and Long Forties
1953	2	—	5	—
1952	3	519	437	330
1951	4	222	251	146
1950	5	104	150	159
1949	6	65	95	131
1948	7	26	34	42
1947	8	26	6	83
1946	9	26	12	21
1945	10	6	2	11
<1945	>10	6	8	77
Total		1000	1000	1000
Number		154	365	144

Table 38. Average Number of Vertebrae (VS), Keeled Scales (K_2), and Gill Rakers (Rf)

	VS	K_2	Rf[1])
Bressay Shoal	56.52	14.43	46.27
Fladen Ground	56.53	14.70	46.17
Long Forties/Gut	56.53	14.78	46.10

[1]) According to Krefft.

important year-classes proved to be as follows: 1952 (330—519‰), 1951 (146—251‰), 1950 (104—159‰). Only in the Long Forties/Gut area the 1949 year-class (131‰) still had some importance. The older year-classes were the first to spawn.

A survey of the number of vertebrae (VS), keeled scales (K_2) and gill rakers (Rf) is given in Table 38. The average values for the vertebrae are 56.52—56.53, for the keeled scales 14.43—14.78, and for the gill rakers 46.10—46.20.

Table 39 shows the average number of vertebrae according to the stages of maturity. The vertebral average of the herrings of stages I—II are always markedly higher than the average for stages II—VII. Also the other characteristics mentioned show different values for these stages of maturity.

The bulk of the herring consisted of summer spawners from the Scottish group, but on the Gut, groups of autumn spawners from the North Sea were also present. The percentage of late winter spawners varied in the catches from 0 to 24, and only on the spawning place at the Turbot Bank could pure summer spawners be observed. In the age composition of the late winter spawners the 1952 year-class was predominant, while the proportion of the 1951 and 1950 year-classes was low. Figure 28 shows the distribution of the year-classes on the Fladen Ground.

During the whole cruise the Atlas "Fischfinder" was running, and Figure 29, where the bottom temperatures are shown, gives the results obtained from the echo-sounder. The greatest density was

Table 39. Average Number of Vertebrae according to the Stages of Maturity

Stages of Maturity	Bressay Shoal	Fladen Ground	Gut
I—II	57.13	56.70	56.65
II	56.86	56.70	56.67
III—VI	56.42	56.50	56.53
VII	56.33	56.41	56.46
VII—II	57.00	56.30	56.58

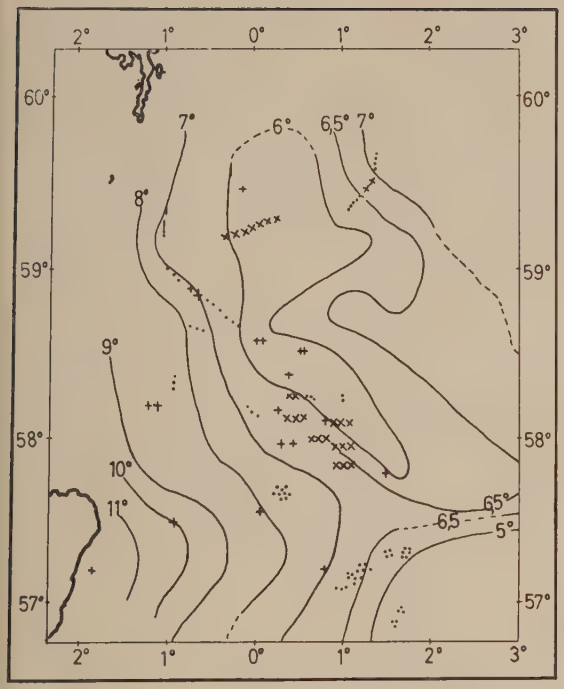


Figure 29. Bottom temperature and echo-sounding records.
× × × × dense records, ++ large single records
+ + + + small single records, ... traces

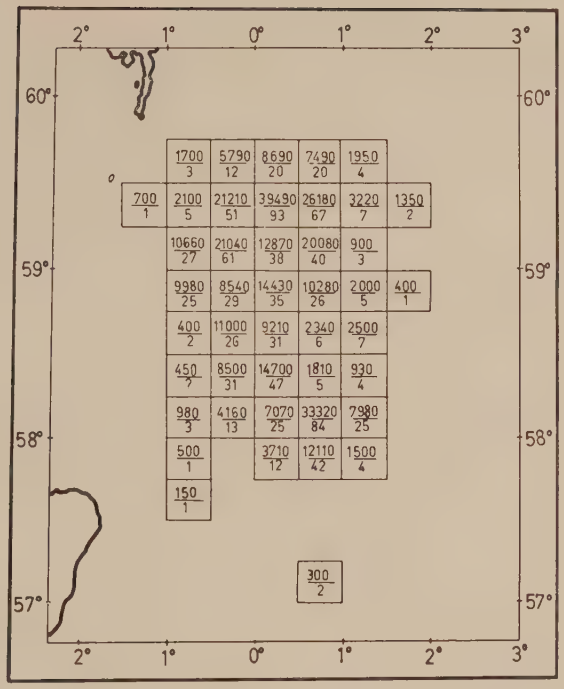


Figure 30. Total catch in baskets (numerators) and number of vessels (denominators) by areas.

observed in a small area on the Fladen Ground and on the Bressay Shoal, and this agreed well with the activity of the fishing fleet. Figure 30 shows the number of trawlers from 1.—20. August and the corresponding yields.

In 1955, the German trawlers had a long fishing period on the Fladen Ground and the Bressay Shoal, the season lasting 100 days. In other years it varied between 59 and 84 days. Only in 1937 and 1947 fishing lasted 91 and 103 days. These years were exceptional by having extremely cold weather in the months January-March. As recorded in the contribution by G. DIETRICH (pp. 71–73), two centres of cold bottom water are to be found, one on the Fladen Ground and the Bressay Shoal, the other on the Gut. We shall consider the first only. In 1955 the bottom temperatures were below 6°C., while in other years these values varied from 6.30—8.70°C. In seasons with long fishing temperatures were always below 6°C. A glance at Figure 30 shows that the best fishing occurred in the cold centre in which the echo-sounder recorded a great density of herrings (see also Figure 29). Perhaps it may be supposed that the long fishing period is dependent on the cooler bottom water, the development of the gonads becoming slower than in other seasons, and in consequence the herrings may stay longer in the area before they are able to spawn.

K. SCHUBERT

The Catches and Landings of Herring at North Shields and off East Anglia in 1955

(Charts 15–28)

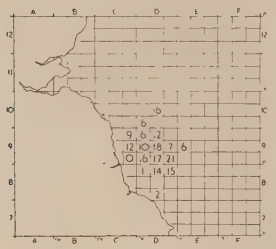
In order to show the density and location of the herring catches a summary of the catch statistics is given by means of charts. Mean landings and mean catches in each small statistical square (1/9 of a statistical rectangle in area) are given for each month.

Charts 15—21 show the distributions of the mean catches from May to November. Charts 22—28 show the distributions of the mean number of landings from May to November.

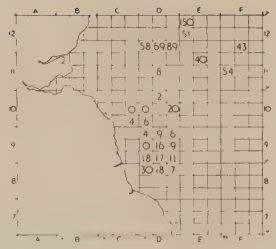
The information was taken from the Daily Collector's Books at North Shields, Great Yarmouth, and Lowestoft.

R. F. CALVER

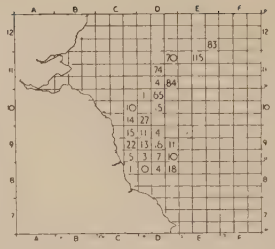
May



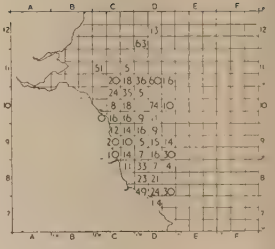
June

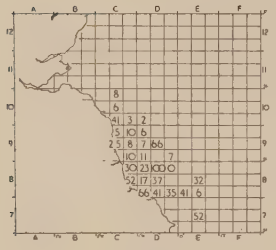


July

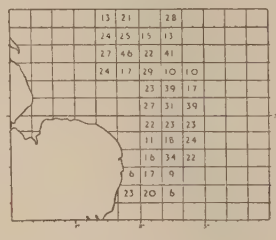


August

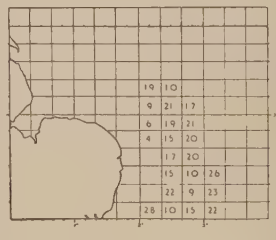




September



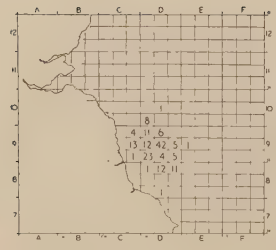
October



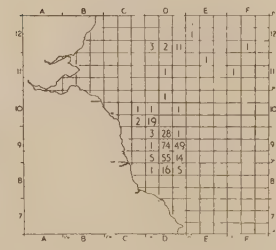
November

Charts 15—21.
Mean catch,
May-November 1955.

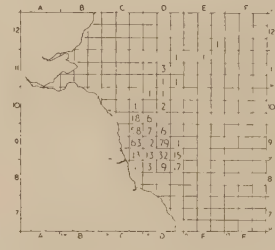
May



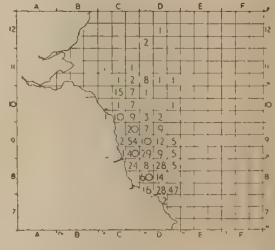
June

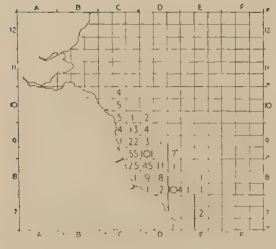


July

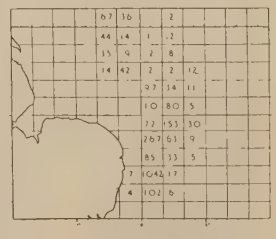


August

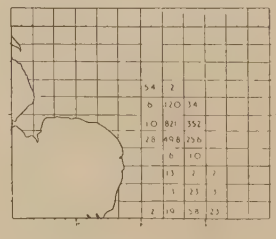




September



October



November

Charts 22.—28.
Mean number of
landings, May-
November 1955.

Coastal Herring from the Mouth of the River Elbe

(Tables 40–41)

In April and May it appears that there were two different herring populations spawning on the German coast. One of these, (originating perhaps in the Zuider Zee) spawns in the River Ems and the other in the estuary of the Elbe, and together, these two groups are of local economic importance, for they have increased in abundance since the end of the war.

Table 40 shows the size distribution and the age composition of the catches.

In 1954 the majority of the catch consisted of herrings 22—24 cm. long (69%) and the most abundant age-group was the four-year-old fish.

Table 40. Length and Age of Herrings in the River Elbe (%)

Length

cm.	19	20	21	22	23	24	25	26	27	28	29
1954	1	7	5	12	34	23	8	9	1	—	—
1955	—	—	2	9	25	23	21	10	9	—	1

Age

years	3	4	5	6	7	8	9
1954	14.0	75.2	6.5	3.2	1.1	—	—
1955	—	46.9	44.4	4.9	1.2	1.2	1.2

Table 41. Average Length, Weight, Age, etc. of Herrings in the River Elbe

Averages of:	1954	1955
Length, cm.	23.06	24.24
Weight, g.	94.60	102.62
Age, years	4.03	5.69
Vert. S.	55.28	55.29
Keeled scales (K_2)	13.88	13.89
Gill rakers (Rf)	45.06	45.51
Numbers examined	200	100

In 1955 these fish (now five-year-olds) were joined by a new 4-year group (46.9%) and the average length of the catch rose from 23.06 to 24.24 cm.

Table 41 gives record of the average length, weight, age, and some meristic characters.

K. Schubert

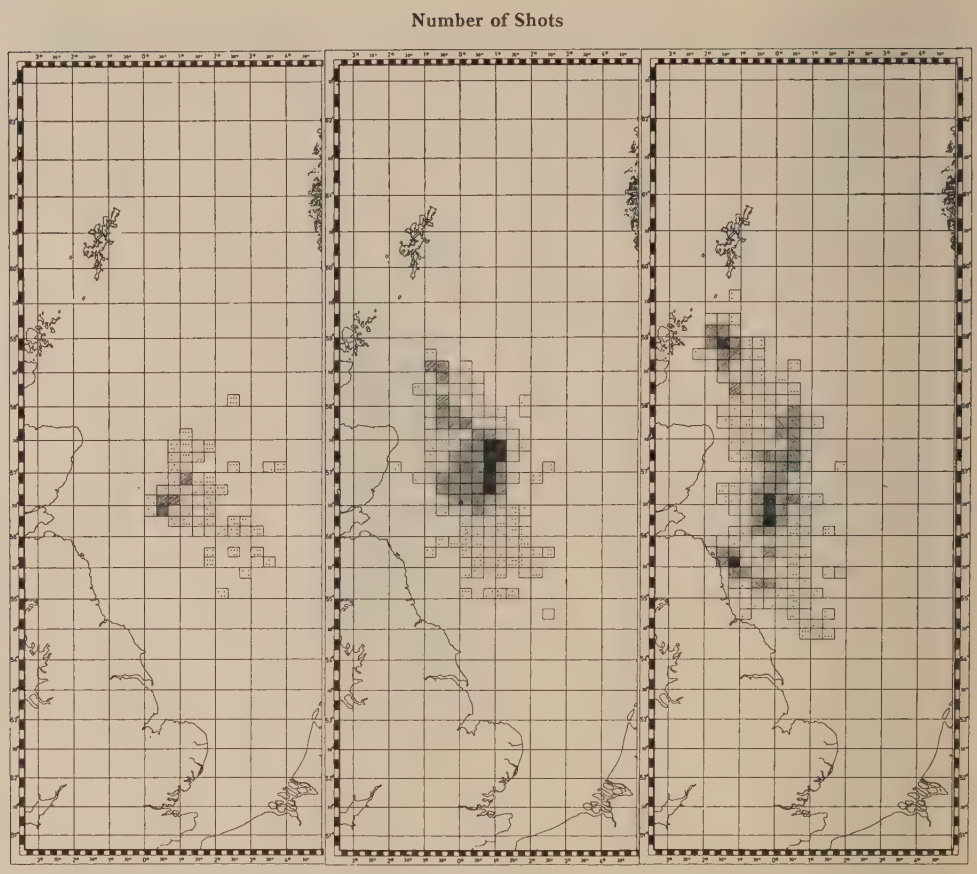
Young Herring from the Bløden Ground Area

(Table 42)

Investigations in the Bløden Area were carried out with the R/V "Dana" in April, May, August and September, while the R/C "Jens Væver" made smaller surveys in April, July, August, and October—November. During these trips hydrographic surveys (vide p. 76), sampling and echo-surveys were carried out. Further herring samples were collected from commercial landings in Esbjerg.

Table 42. Meristic Characters of Samples from the Bløden Ground Area, 1955

Date	Numbers examined	1952 year-class: %	Aver. length, cm.	Aver. K_2	Aver. Vert. S.	1953 year-class: %	Aver. length, cm.	Aver. K_2	Aver. Vert. S.	1954 year-class: %	Aver. length, cm.	Aver. K_2	Aver. Vert. S.
27. January	160	80	20.8	14.84	56.51	16	16.8	14.77	56.52	0	—	—	—
15. February	150	7	—	—	—	93	15.0	14.71	56.45	0	—	—	—
27. February	120	14	19.2	—	—	61	15.3	14.67	56.51	0	—	—	—
28. February	150	5	—	—	—	61	13.3	14.57	56.45	0	—	—	—
1. March	50	1	—	—	—	99	13.5	—	56.45	0	—	—	—
1. March	150	0	—	—	—	100	14.0	14.58	56.42	0	—	—	—
1. April	155	16	20.0	14.73	56.55	81	14.9	14.33	56.66	0	—	—	—
18. July	105	1	—	—	—	99	17.9	—	56.53	0	—	—	—
22. August	150	0	—	—	—	100	17.7	14.80	56.55	0	—	—	—
7. September	95	0	—	—	—	98	18.0	—	56.69	2	—	—	—
14. September	144	1	—	—	—	78	18.9	14.85	56.77	21	15.4	14.60	56.54
14. September	100	2	—	—	—	98	21.2	14.64	56.69	0	—	—	—
17. September	150	10	23.5	—	—	89	20.5	14.56	56.59	0	—	—	—
20. September	130	1	—	—	—	99	18.6	14.84	56.62	0	—	—	—
25. September	100	2	—	—	—	98	19.9	14.87	56.57	0	—	—	—
29. September	100	13	24.8	—	—	87	19.8	14.97	56.74	0	—	—	—
29. September	110	33	23.2	14.91	56.43	67	21.4	14.53	56.68	0	—	—	—
6. October	100	1	—	—	—	21	20.6	14.94	56.89	78	14.3	14.29	56.42
31. October	159	3	—	—	—	82	19.7	14.84	56.66	14	15.3	—	56.68
31. October	113	2	—	—	—	55	19.9	—	56.61	43	16.1	—	56.71
11. November	155	0	—	—	—	6	—	—	—	94	14.0	14.56	56.48
11. November	171	5	—	—	—	19	19.6	14.53	56.57	71	15.0	14.45	56.65



Charts 29—31. May June July

The commercial landings amounted to a total of 63.6 mill. kg. (64.1 mill. kg. in 1954) including smaller amounts of other species. The fishery seems to be stabilized, and only a small further increase of intensity is to be expected in the future.

The yield of the spring fishery was lower than in 1954 (8.3 mill. kg. against 15.1 mill. kg. in 1954), and this was in accordance with our prediction of 1954, but it is possible that the cold weather in February may have played a part in the decline of catches. The composition of the stock (Table 42) was in accordance with earlier observations, and the II-group seemed to be almost absent, thus confirming the impression that the year-class of 1952 was rather scarce so far as the late autumn-spawned component was concerned.

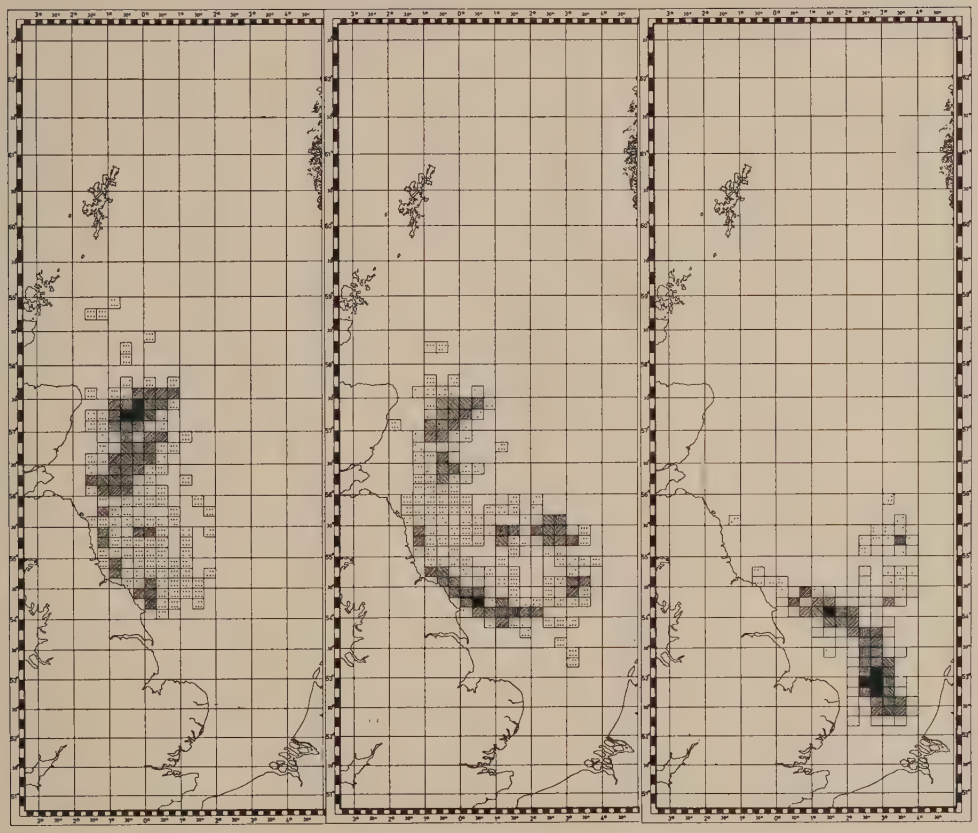
The yield of the autumn fishery amounted to 55.3 mill. kg. compared with 49.0 mill. in 1954. The fishery was rather scattered in the beginning of the season probably due to the much wider distribution of cold bottom water compared with former years, and as the herring shoals were confined to the cold bottom water they had a wider area of movement. Stock composition during the autumn season was more like that of 1953 than that of 1954. The late autumn-spawned component of the 1953 year-class appears to be more abundant than that of the year-class of 1952. Also the earlier autumn-spawned component of the 1954 year-class would seem to be more abundant according to the frequent occurrence of the 0-group during the last months of the season.

According to this, one may predict an increase in yield of the spring season 1956 and good prospects for the following autumn season.

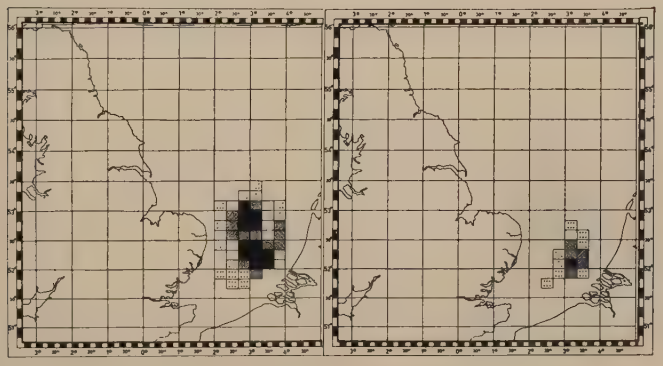
A review of the investigations from 1951 to the present is being prepared.

E. Bertelsen, K. Popp Madsen

Number of Shots

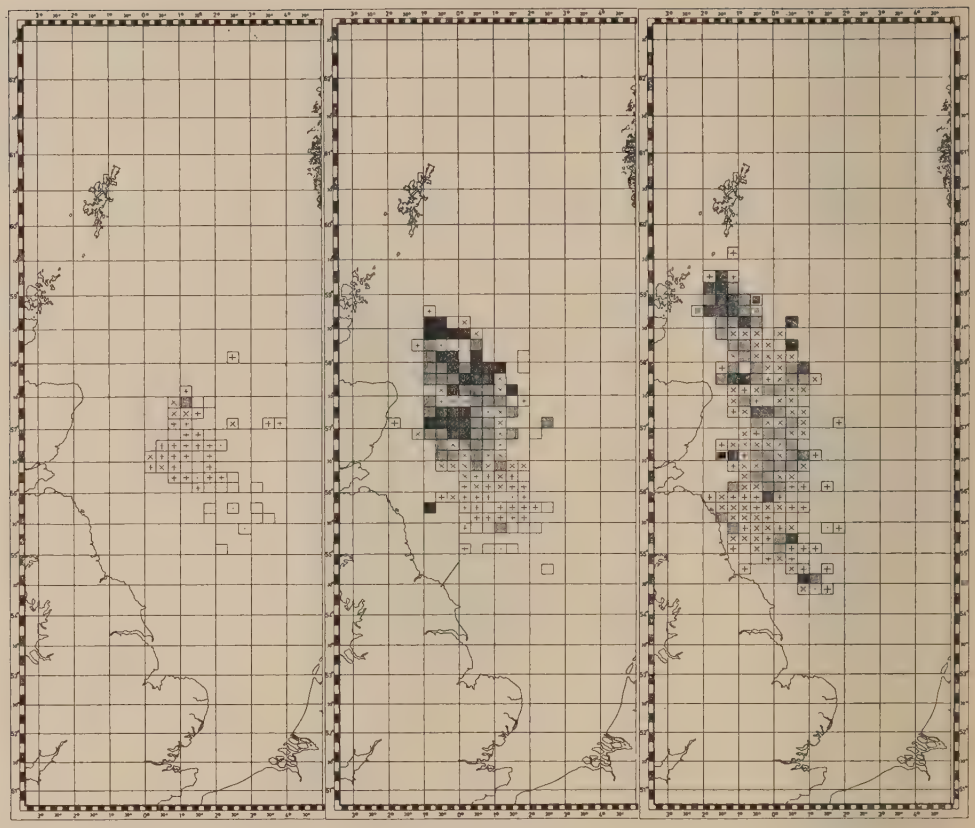


Charts 32—34. August September October



Charts 35—36. November December

Mean Catch per Shot (in Kantjes)



Charts 37—39 May June July

The Dutch Herring Fisheries in 1955

(Table 43 and Charts 29–57)

Drift-net fisheries

As in 1954, most Skippers of drift-net vessels gave information about the size of their catches and the area of the fishing. Charts 29—52 show the results.

Fishing started on 23. May, and from then until 31. May the number of nets shot was 60. Then 80 nets were used until 1. August, when the number rose to about 100 and remained there for the rest of the season.

The distribution of the fleet differed somewhat from that of last year, the luggers working generally in a more northern area. The fishery in the north also lasted longer than in most years, and until September, luggers were fishing in the Scottish north-east coast region.

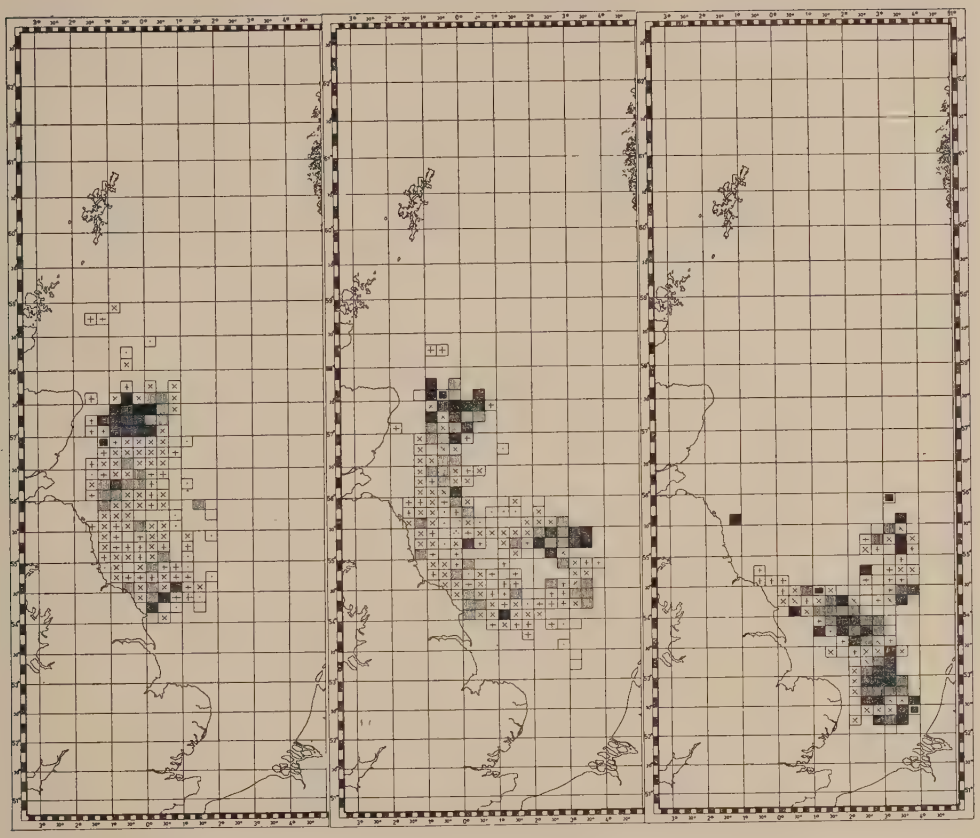
Fishing on the Dogger again ended early this year, but the summer fishery on the northern grounds was one of the best since the war. The fishing in June was especially good. In August and September the catches were about the same as in 1954, except the rather big catches made in September off the Scottish north-east coast.

The East Anglian season was a complete failure, the catch per shot being the lowest since the war and less than half of last year's, and both the October and November catches were poor compared with 1954 (see Ann. Biol., Vol. XI).

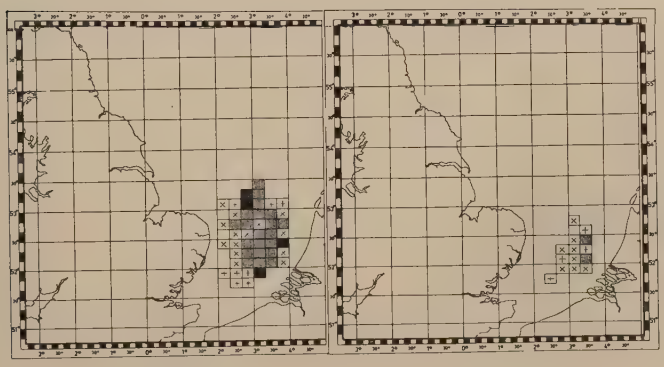
The Channel fishery (not shown in the charts) was about the same as in 1954 and gave rather bad results.

The charts of the maturity stages ("sorting") show about the same general picture as in 1954. Table 43A gives the total quantity of drift-net herring landed and it will be seen that the catches

Mean Catch per Shot (Kantjes)

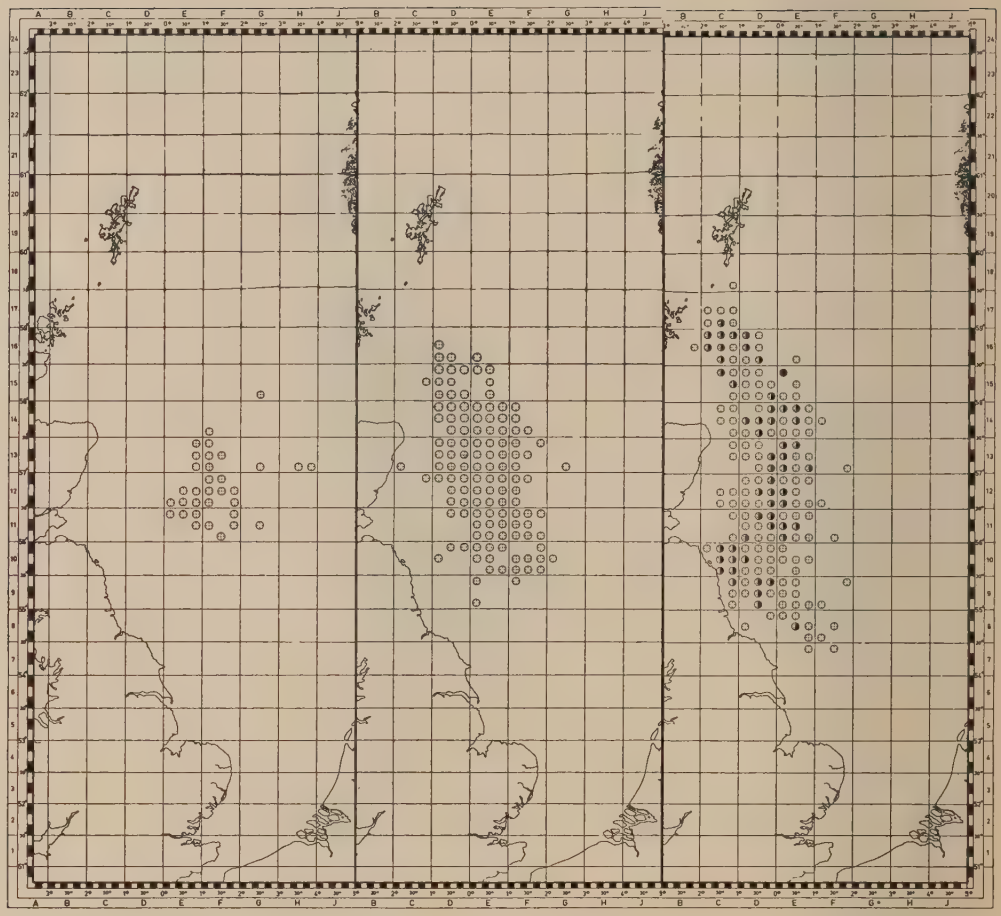


Charts 40 –42. August September October



Charts 43—44. November December

Sorting

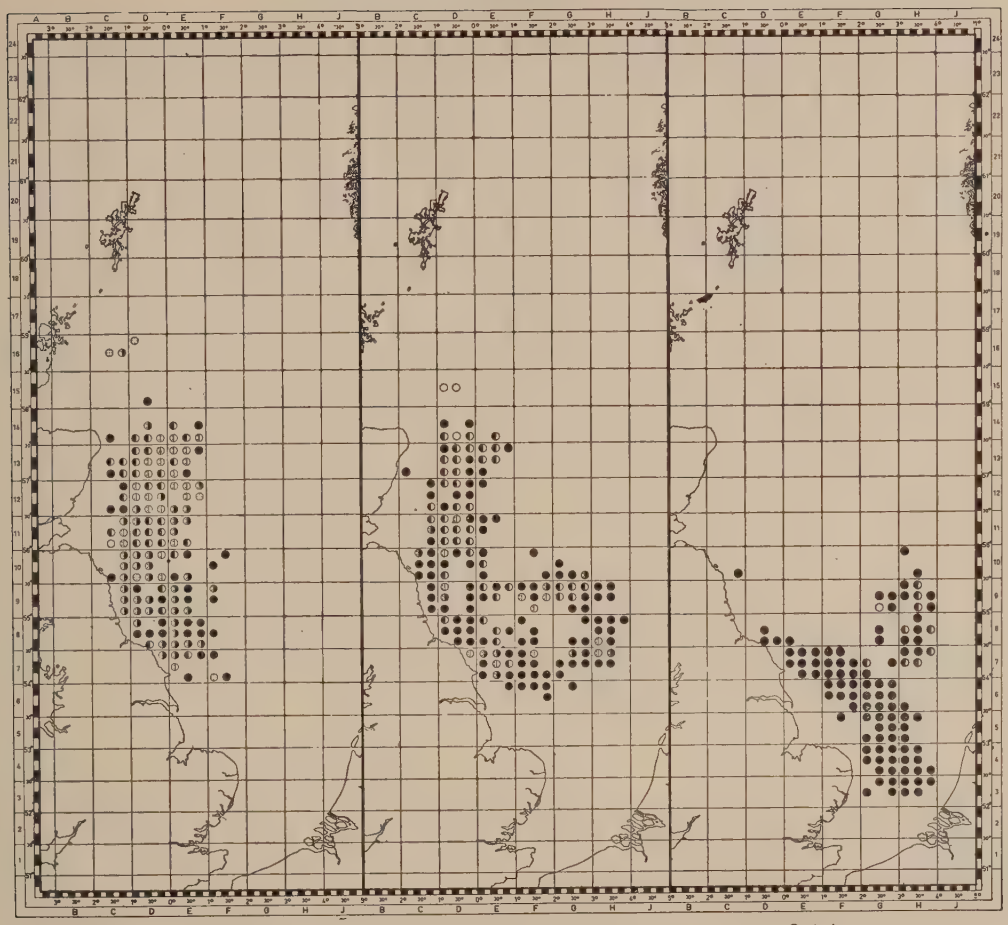


Charts 45—47. May June July

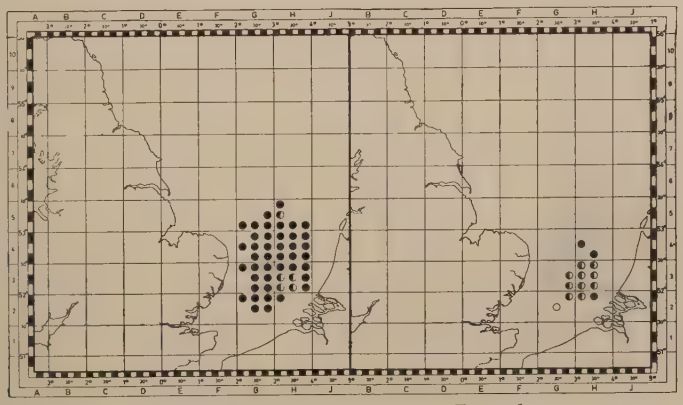
Table 43. Quantities of Herring landed in Dutch Ports in 1955

Month	A. Landed by Luggers fishing with Drift-Nets					B. Trawled Herring (in tons)	
	Salted herring (in kantjes) Gutted			Ungutted	Fresh herring (in kg.)	Trawlers	All kinds of vessels
	Matjes	Full	Spent				
January	—	—	—	—	50,800	82	315
February	—	—	—	—	—	155	189
March	—	—	—	—	—	245	503
April	—	—	—	—	68,000	287	484
May	499	—	—	—	182,550	153	255
June	90,767	—	—	11,342	1,070,493	77	93
July	100,306	413	—	7,972	744,965	1,247	2,864
August	16,233	32,766	10,358	25,861	168,789	3,429	10,279
September	4,118	40,230	8,503	23,648	38,375	3,645	12,941
October	553	39,598	3,223	122,097	2,437,967	1,303	4,711
November	—	8,917	394	136,983	2,846,350	888	1,459
December	—	1,709	199	77,351	255,113	490	2,323
Total	212,476	123,633	22,677	405,254	7,863,402	12,001	36,416

Sorting



Charts 48—50. August September October



Matjes

Matjes and Full

Matjes, Full and Spent

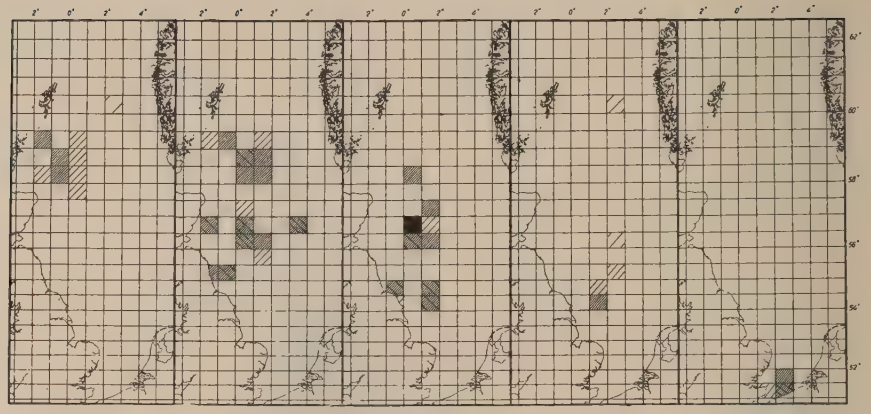
Full and Spent

Full

Spent

Charts 51—52. November December

Dutch Trawl Catches per 100 Hours Fishing



Charts 53—57. July August September October November

5,000—10,000 kg.
10,000—25,000 kg.
25,000—50,000 kg.
50,000— 75,000 kg.
75,000—100,000 kg.
100,000—150,000 kg.

of herring in the period of January-May (not shown in the charts) were very low compared with those of the previous year. The total weight of herring landed by drift-net fisheries was 77,476 tons, (96,999 tons in 1954).

Trawl fisheries

The catches of herring per 100 hours fishing by the Dutch steam and motor trawlers, fishing with the herring trawl, are shown in Charts 53—57.

The catches on the Fladen Ground and in the central North Sea (the Gut) were somewhat higher than in 1954. The Dogger area again gave poor results, compared with those of a few years ago and the catches here have gone down steadily during the period 1950—1955, from 130 to 70 tons per 100 hours fishing.

The fishing in the Sandettié and Channel region on spawning herring concentrations was a complete failure, and in consequence most trawlers left the area. The poorness of the fishing is clearly seen by comparing the November and December catches for 1955 with those for the previous year.

Table 43 B gives the quantity of herring landed by the trawlers and by the whole fleet fishing with trawl nets in 1955, and it will be seen that in most months, landings were well below those of 1954. The total quantity landed was about 23% lower than in 1954, and for the trawlers the decrease amounted to 40%.

J. J. Zijlstra

Full-Herring Concentrations exploited by the Belgian Herring Trawlers in 1955

(Figure 31, Tables 44–56)

1. Activity—Landings

As during previous years, the full-herring fishery started on 15. July and was carried out on the usual grounds, viz., on the Bressay Bank and the Fladen Ground. During August and September the fishery took place on the Lemon and Turbot Banks, the Eastern Hole and the Gut. During September and October on the Brucey's Garden, N.W. Rough, Hospital and Skate Hole and as from November and during December around the lightships "West-Hinder", "Ruytingen", "Sandettié" and "East Goodwin".

In the northern and central areas of the North Sea, the fishery was carried out exclusively with the otter-trawl, whereas in the southern area 98% of the catches were taken by the pelagic trawl, towed by two trawlers fishing together. The results gained by each method are given separately.

The total landings of this fishery amounted to 9,357 tons of fish including 9,161 tons of herring (97.91%). The otter-trawl produced 1,229 tons of herring (13.40%), the pelagic trawl 7,933 tons (86.60%).

2. Fishery

Tables 44—46 give records of the fishing effort and the yield of the fishery, as regards vessels

Table 44. Number of Trips with Otter-Trawl and Fishing Effort

Months	Number of trips				Fishing effort (1,000 F.H. × H.P.)			
	North.	Centr.	South.	Total	North.	Centr.	South.	Total
July	3	—	—	3	232	—	—	232
August	4	3	—	7	198	217	—	415
September	—	6	—	6	—	174	—	174
October	1	16	—	17	82	498	—	580
November	—	—	—	—	—	—	—	—
December	—	—	19	19	—	—	91	91
Total 1955	8	25	19	52	512	889	91	1,492
Total 1954	15	35	7	57	1,292	1,403	201	2,896

operating with the otter-trawl. Only 15 trawlers participated in the fishery and made 52 trips during the season (Table 44). The catches were mainly composed of herring (Table 45), the yield of which totalled 1,228 tons (Table 46) or 88.39% as against 2,466 tons in the previous season. The catch per trip (24 tons) was 44.18% lower than in the previous season (43 tons). Table 47 shows the number of trips, total catch and yield per trip from the pelagic fishery. It appears that in the southern area the yield per unit of effort (F.H. x H.P.) of the otter-trawlers is only 52.35% of that from the pelagic trawlers.

Table 45. The Total Yields by Otter-Trawl Vessels

	Species	Tons	‰
Pelagic	Herring	1,228	884
,,	Sprat	—	—
,,	Mackerel	76	54
Demersal	Haddock	27	20
,,	Cod	9	6
,,	Saithe	7	5
,,	Whiting	29	21
,,	Others	14	10
Total pelagic species		1,304	938
Total demersal species		86	62
Grand total		1,390	1,000

3. The herring stock

The material investigated consisted of 14 samples comprising 1,195 fish covering the central (635) and the southern (560) area. It was collected in August (200), September (180), October (255), November (350), and December (210).

Table 48 shows the size distribution of the herring by areas and from month to month during the season. The average weight and the percentage number of males are also recorded. The average size of the fish (273 mm.) was higher than in 1954 (265 mm.), the average weight was 172 g. against 160 g. in 1954.

Table 47. Fishing Effort and Yield (Pelagic Trawl)

Months	Number of trips	Total catch (tons)	Average catch per trip (tons)	Fishing effort (1000 F.H. × H.P.)
October	26	443	17.0	99
November	439	5108	11.6	1308
December	272	2382	8.8	788
Total 1955	737	7933	Mean 10.8	2195
Total 1954	214	1912	Mean 8.9	1151

Table 46. The Yields of Herring (Otter-Trawl)

Months	Total catch (tons)				Catch per trip (tons)			
	North.	Centr.	South.	Total	North.	Centr.	South.	Total
July	86	—	—	86	29	—	—	29
August	146	139	—	285	37	46	—	41
September	—	166	—	166	—	28	—	28
October	11	509	—	520	11	32	—	31
November	—	—	—	—	—	—	—	—
December	—	—	172	172	—	—	9	9
Total 1955	243	814	172	1,229	31	33	9	24
Total 1954	794	1481	191	2,466	53	42	27	43

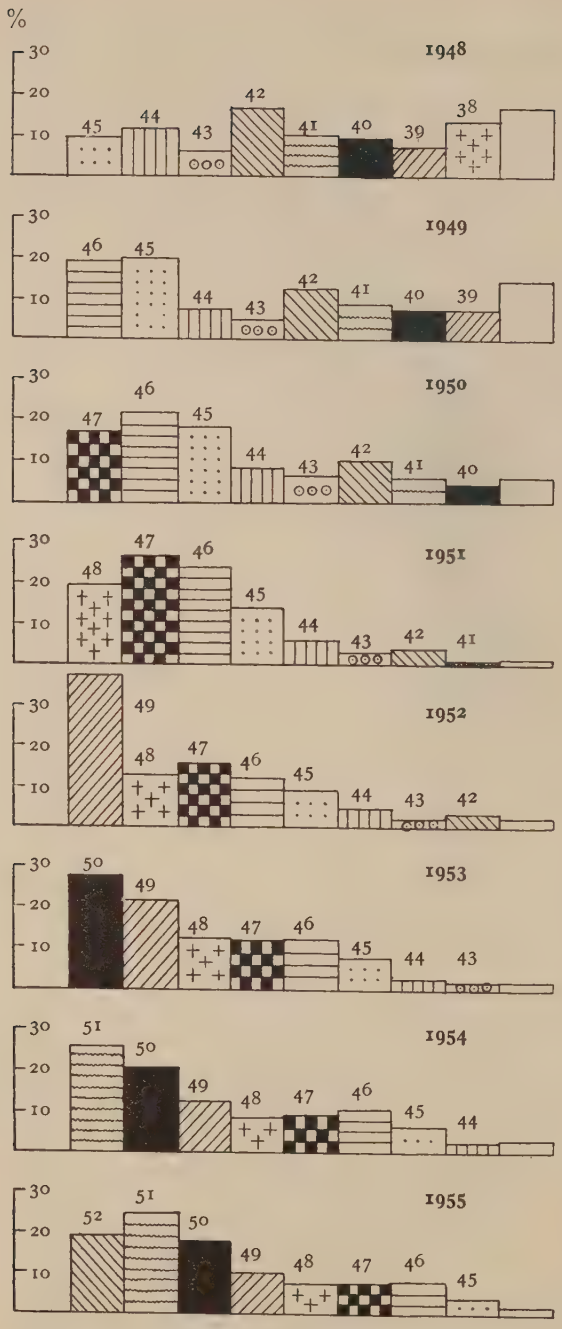


Figure 31. Biological scale of the full-herring concentrations exploited by the Belgian herring trawlers 1948—55.

As to the maturity it is evident from Table 49 that stage V was largely predominating in the central and stage VI in the southern area. As in earlier investigations the quantity of intestinal fat was estimated. The results are shown in Table 50.

The age composition of the catches is shown in Table 51. It appears that the 4-year-old fish were predominant in all areas. The sequence of the most important year-classes, as to their relative strength, proved to be as follows: 1951 (234‰), 1952 (205‰), 1950 (123 ‰) and 1949 (119‰).

Table 48. Size, Weight, and Sex (‰)

cm.	By Areas Centr.	South.	Total	By Months Aug.	Sept.	Oct.	Nov.	Dec.
31.....	28	2	16	30	55	8	3	—
30.....	140	32	90	85	244	110	34	28
29.....	**235**	114	**178**	**245**	**267**	**204**	94	148
28.....	123	173	146	140	100	125	169	**181**
27.....	95	145	118	100	79	102	143	148
26.....	97	**180**	136	110	72	106	**183**	176
25.....	132	159	145	135	100	153	180	124
24.....	95	122	107	85	50	133	114	133
23.....	46	68	56	55	33	47	74	57
22.....	6	5	6	5	—	12	6	5
21.....	3	—	2	10	—	—	—	—
Total ..	1000	1000	1000	1000	1000	1000	1000	1000
Average length, mm. .	277	268	273					
Mode, cm. ..	29	26	29					
Weight, g.	185	158	172					
Males, ‰	498	457	479					

Table 49. Stages of Maturity (‰)

Stages	By Areas Centr.	South.	Total	By Months Aug.	Sept.	Oct.	Nov.	Dec.
I	5	2	3	10	—	4	3	—
II	57	3	32	70	111	8	6	—
III	35	—	18	100	11	—	—	—
IV	74	2	40	220	17	—	3	—
V	**423**	429	**426**	**545**	**439**	318	**609**	129
VI	345	**453**	396	—	383	**588**	277	**748**
VII	8	29	18	—	—	19	5	66
VIII–II	53	82	67	55	39	63	97	57
Total ..	1000	1000	1000	1000	1000	1000	1000	1000

Table 50. Quantity of Intestinal Fat (‰)

Quantity	By Areas Centr.	South.	Total	By Months Aug.	Sept.	Oct.	Nov.	Dec.
0	258	305	280	70	272	396	229	433
1	**547**	**682**	**610**	**520**	**517**	**588**	**751**	**567**
+	142	13	81	290	167	8	20	—
M	53	—	29	120	44	8	—	—
Total ..	1000	1000	1000	1000	1000	1000	1000	1000

Table 51. Age (‰)

Age	Year-class	By Areas Centr.	South.	Tot.	By Months Aug.	Sept.	Oct.	Nov.	Dec.
3	1952	181	230	205	167	**143**	**229**	237	217
4	1951	**194**	**275**	**234**	**250**	137	199	**290**	**243**
5	1950	80	167	123	118	58	66	162	178
6	1949	117	123	119	146	117	90	125	118
7	1948	73	78	76	49	91	78	74	85
8	1947	69	53	61	62	84	60	47	66
9	1946	120	36	79	104	143	115	34	40
10	1945	37	29	33	7	65	36	24	40
>10	<1945	129	9	70	97	162	127	7	13
Total	.....	1000	1000	1000	1000	1000	1000	1000	1000

Table 52. Age Composition of the Catches during 1948—1955 (‰)

Age	Years 1948	1949	1950	1951	1952	1953	1954	1955	Av.
2	—	—	—	—	—	4	21	—	5
3	14	45	99	34	146	196	231	205	156
4	167	91	**278**	163	148	**243**	**265**	**234**	**213**
5	94	122	158	**305**	135	127	135	123	137
6	**176**	114	78	180	**201**	91	79	119	117
7	153	**192**	89	90	126	139	66	76	112
8	167	145	96	56	62	69	78	61	84
9	97	165	73	69	45	35	35	79	67
10	45	77	66	56	57	39	25	33	45
>10	87	49	63	47	80	57	65	70	64

Table 53. Average Lengths by Age and the Value of L_1 (mm.)

Brood	Lengths Centr.	South.	Mean	L_1 Centr.	South.	Mean
1952...	249	245	247	139	136	137
1951...	264	261	262	122	126	124
1950...	279	275	276	120	125	123
1949...	289	285	287	119	115	117
1948...	294	289	292	121	109	115
1947...	295	292	294	119	118	119
1946...	297	292	296	115	114	115
1945...	302	296	299	118	116	117
<1945...	301	298	301	122	120	122
Averages	280	269	275	123	124	124

It is of great interest to compare the age composition of the catches from year to year as is done in Table 52. The table deals with the 8-year period from 1948 to 1955. It is seen that the absolute dominant is found in one of the age-groups IV—VII. It seems that the 1946-brood has been the most successful one during the period, being an absolute dominant through 3 subsequent years (1950—1952). It is also interesting to note that during recent years (1950—1955) the fish has tended to be younger than before, taking the stock as a whole. At the same time there has been a general trend towards increased average length of the whole stock (Table 53). On the other hand the growth-rate during the first year (L_1) does not seem to have changed very much (Table 53).

For the two regions as a whole, the number of vertebrae varies between 54 and 59 (Table 54). The spines with 57 vertebrae dominate the samples and the vertebral average was found to be 56.561. For the central area these values are as follows: 54 to 58 vertebrae; mode: 56; vertebral average: 56.511; for the southern area: 55 to 59 vertebrae; mode: 57; vertebral average: 56.619.

It is rather surprising that the vertebral average for the southern area is markedly higher, as the average is usually more or less equivalent for the two regions.

Table 55. Average Number of Vertebrae according to the Stages of Maturity

Maturity stages	Central Number	Vertebral average	Southern Number	Vertebral average
I	3	57.00	1	57.00
II	35	56.63	2	56.50
III	21	56.38	—	—
IV	46	56.57	1	57.00
V	261	56.49	232	56.65
VI	213	56.50	246	56.59
VII	4	56.50	16	56.56
VIII—II	34	56.62	43	56.67
Total	617	56.51	541	56.62

Table 54. Vertebrae (VS ‰)

VS	By Areas Centr.	South.	Total	By Months Aug.	Sept.	Oct.	Nov.	Dec.
59	—	2	1	—	—	—	3	—
58	55	63	59	72	45	49	71	—
57	434	**519**	**474**	436	435	433	**490**	49
56	**480**	385	435	**451**	**492**	**494**	406	**569**
55	28	31	29	36	28	20	30	348
54	3	—	2	5	—	4	—	34
Total	1000	1000	1000	1000	1000	1000	1000	1000
Average	56.511	56.619	56.561	56.533	56.497	56.502	56.611	56.632

Table 56. Keeled Scales (K_2) in $^0/_{00}$

K_2	By Areas			By Months				
	Centr.	South.	Total	Aug.	Sept.	Oct.	Nov.	Dec.
19	2	2	2	5	—	—	3	—
18	2	2	2	—	—	4	—	5
17	39	18	29	21	76	28	20	15
16	162	144	153	142	129	200	132	164
15	417	476	445	416	450	396	494	444
14	317	304	311	342	257	340	293	324
13	61	52	57	74	88	32	55	48
12	—	2	1	—	—	—	3	—
Total	1000	1000	1000	1000	1000	1000	1000	1000
Average	14.813	14.778	14.797	14.716	14.848	14.864	14.773	14.787

Finally, Table 56 gives the number of keeled scales (K_2) by areas and by months. The average number for the whole season was found to be 14. 797.

Stomach analyses were made on all herring investigated. Only 1% was found to contain food, mostly remains of copepods.

CH. GILIS

Spent-Herring Concentrations exploited by the Belgian Herring Trawlers in 1955—56

(Figure 32, Tables 57–66)

1. Fishing effort

The first spent-herring catches were landed on 19. December 1955 and the last on 20. February 1956.

During this period, the Belgian fishery was localized in the extreme south of the North Sea and mainly in the relatively small area limited by the lightship "West-Hinder", the eastern English Channel; the lightships "Ruytingen" and "Sandettié".

All spent-herring catches were caught with the pelagic trawl, towed by two trawlers fishing together.

In Table 57 a survey is given of the fishing effort and the yields, comparison being made with the previous season. In this season 62 trawlers were engaged in the fishing (56 in 1954—55) and 442 (661) voyages were made.

2. Landings

The total catch amounted to 3,628 tons consisting of 3,595 tons of herring (99.08%) and 33 tons of other species (0.92%).

In Table 57 details are given of the landings made by the pelagic trawl. The average yield per trip varied considerably from month to month. It reached its maximum in January 1956 with 9.6 tons and the average yield for the whole season was 8.1 tons as against 12.1 tons during the previous season.

It is also of interest to consider the effort made and the yield of this effort for a series of seasons as is done in Table 58. It appears that the number of fishing vessels participating, the number of trips made, the total yield and the yield per unit of

Table 57. Fishing Activity. Total Yields and Yields per Unit of Effort (Pelagic Trawl)

Months	Effort			Catch		
	Vessels	V. × H.P. (1000)	Trips	Total (tons)	Per trip (tons)	Per V. × H.P. (kg.)
December ..	58	31.3	79	367	4.6	12
January ...	60	105.1	272	2620	9.6	25
February ..	42	33.5	91	608	6.7	18
1955—56...	62	169.9	442	3595	8.1	21
1954—55...	56	234.0	661	7977	12.1	34

Table 58. Survey of Fishing Effort and Yields during the Seasons 1950—51 to 1955—56[1])

Spent-herring season	Number of trawlers	Number of trips		Total (tons)	Weight landed per 1 H.P. × F.D.	
		Individual trawlers	Bull-net trawlers		Individual trawlers (kg.)	Bull-net trawlers (kg.)
1951—52	52	225	177	3,475	26	43
1952—53	70	—	561	6,130	—	33
1953—54	89	—	594	10,173	—	52
1954—55	56	—	661	7,977	—	34
1955—56	62	—	442	3,595	—	21

[1]) For details of the seasons from 1941 to 1951, see Ann. Biol., XI, p. 151, Table 35.

effort have decreased. Another important feature has been the introduction of the bull-net.

3. The herring stock

During the season, 755 herrings were investigated, 120 in December, 400 in January, and 235 in February.

The size distribution, the average size and the weight of the herring from month to month, can be seen in Table 59. It must be noted that the average length (272 mm.) as well as the weight (127 g.) proved to be a little higher than in the previous season (266 mm., 123 g.).

The age composition of the stock is shown in Table 60. The fishing was evidently based on 3 to 6-year-old herrings (year-classes 1949—1952), which together formed 71.8% of the total catch. The 5-year-old fish (1952) made up 18.9% of the total.

Table 59. Spent Herring. Length, Weight, and Sex

Length ‰ Cm.	Southern North Sea Dec.	Jan.	Feb.	Average
31	—	5	—	3
30	8	40	8	25
29	117	**210**	98	160
28	191	200	**179**	**192**
27	167	173	175	172
26	**200**	160	153	164
25	117	127	162	136
24	117	55	132	89
23	75	25	64	45
22	8	5	8	7
21	—	—	13	4
20	—	—	—	—
19	—	—	8	3
Total	1000	1000	1000	1000
Average length, mm.				272
Average weight, g...				127
Males, ‰				449

Table 60. Age Distribution (‰). N = 683

Winter-rings	Age Years	Year-class	Southern North Sea Dec.	Jan.	Feb.	Average
1	2	1953	—	—	10	3
2	3	1952	212	135	**276**	189
3	4	1951	**331**	**241**	199	**244**
4	5	1950	110	190	209	182
5	6	1949	76	114	97	102
6	7	1948	68	89	41	72
7	8	1947	93	71	66	73
8	9	1946	59	98	46	76
9	10	1945	34	49	31	41
>9	>10	<1945	17	13	25	18
Total			1000	1000	1000	1000

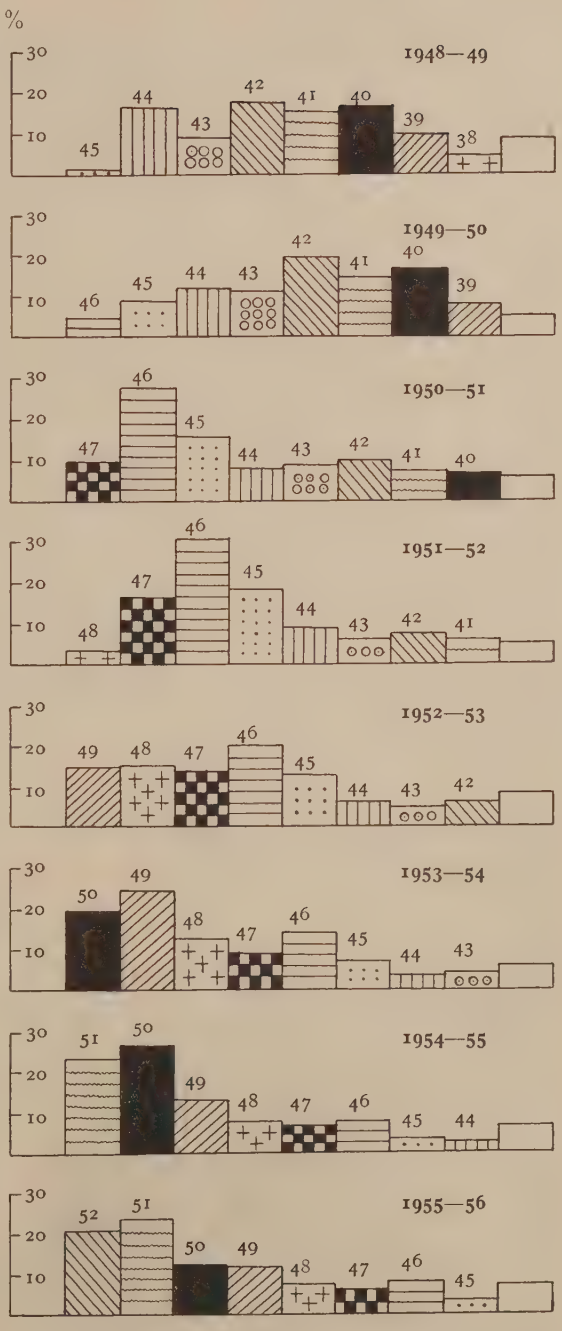


Figure 32. Biological scale of the spent-herring concentrations exploited by Belgian herring trawlers during 1948—49 to 1955—56.

Table 61. Age Composition of the Catches during 1951—52 to 1955—56 (‰)

Age	1951–52	1952–53	1953–54	1954–55	1955–56	Aver. 1948–56
2	4	12	5	4	—	4
3	197	372	276	245	189	214
4	266	124	216	211	244	194
5	237	153	125	134	182	134
6	140	120	119	95	102	112
7	65	95	121	94	72	95
8	32	46	80	105	73	80
9	39	24	25	62	76	54
10	4	30	16	24	41	49
>10	16	24	17	26	18	64

Table 62. Average Length. First Year's Growth (L_1) of the various Year-Classes (in mm.)

	Southern North Sea							
	Average length				Growth of the 1st year (L_1)			
Year-class	Dec.	Jan.	Feb.	Aver.	Dec.	Jan.	Feb.	Aver.
1953	—	—	205	205	—	—	122	122
1952	243	249	244	246	129	138	136	135
1951	262	263	258	262	130	126	124	126
1950	274	275	274	275	118	124	121	122
1949	283	285	279	283	109	104	112	107
1948	285	290	286	288	107	108	108	108
1947	291	290	287	290	111	116	110	113
1946	288	292	290	291	112	110	115	111
1945	292	295	293	294	113	105	119	110
<1945	298	297	295	296	109	94	110	103
Averages ..	268	275	266	271	122	119	123	121

Table 63. Survey of the Average Length (mm.) during the last 5 Seasons

	Age							
Seasons	3	4	5	6	7	8	9	10
1951—52	235	250	260	265	270	276	274	277
1952—53	239	255	268	271	276	279	281	280
1953—54	240	260	270	278	280	283	286	287
1954—55	242	261	275	281	286	286	290	287
1955—56	246	262	275	283	288	290	291	294
Average 1948—56	237	254	264	271	276	279	282	282

Table 64. Total Number of Vertebrae (VS ‰)

	Southern North Sea			
VS	Dec.	Jan.	Feb.	Average
58	68	78	53	69
57	504	541	507	525
56	402	345	418	376
55	26	34	22	29
54	—	3	—	1
Total	1000	1000	1000	1000
Average	56.615	56.658	56.591	56.630

Table 65. Stages of Maturity (‰)

	Southern North Sea			
Stages	Dec.	Jan.	Feb.	Average
I	8	—	13	5
II	—	—	—	—
III	—	—	—	—
IV	—	—	—	—
V	—	2	—	1
VI	—	8	—	4
VII	133	20	—	32
VIII—II	859	970	987	958
Total	1000	1000	1000	1000

Table 65a. Quantity of Intestinal Fat (‰)

	Southern North Sea			
Quantity	Dec.	Jan.	Feb.	Average
0	200	82	157	124
1	792	918	809	864
+	—	—	34	11
M	8	—	—	1
Total	1000	1000	1000	1000

Table 66. Keeled Scales (K_2) in ‰

	Southern North Sea			
K_2	Dec.	Jan.	Feb.	Average
17	17	15	13	15
16	178	127	184	153
15	457	471	508	480
14	314	339	269	313
13	34	48	26	39
12	—	—	—	—
Total	1000	1000	1000	1000
Average	14.831	14.722	14.889	14.791

The average length of each particular year-class is recorded in Table 62, together with the growth of the first year (L_1) up to the formation of the first winter-ring.

It is of great interest to compare, over a period of seasons, the average length of the herring in relation to age as is done in Table 63. It is quite striking that a general increase in length has taken place.

The number of vertebrae was a little higher than last year being 56.63 (against 56.60) as shown in Table 64. The frequency distribution in different months is also shown in this table.

Tables 65 and 65 a illustrate the number of herrings in the different stages of maturity from month to month (Table 65) and the relative quantity of intestinal fat, also by months. As usual, the greatest part of the stock was made up of spents or recovering spents, and the small amount of fat is in good agreement with that fact.

Finally, Table 66 gives the number of keeled scales (K_2). The average number for the whole period was found to be 14.791.

CH. GILIS

Full-Herring Concentrations of the "Smalls" in 1955

(Tables 67–75)

1. Activity—Landings

During the 1955 season the full-herring fishery on the Fladen Ground was found to be rather poor. In consequence the majority of the herring trawlers turned their efforts to the Smalls full-herring fishery, where the catches were much more remunerative. The first landings of Smalls herring took place on 9. July and the last ones on 12. November 1955. All catches were made with the otter-trawl.

The total landings of this fishery amounted to 4,412 tons of fish of which 4,130 tons were herring (93.61%). The other species of pelagic fish gave 8.7 tons (0.20%) and of demersal fish, 273 tons (6.19%).

2. Fishery

Tables 67—69 give records of the fishing effort and the yields of the fishery. 16 trawlers participated in the fishery and made 83 trips during the season (Table 67). The catches of herring reached 4,130 tons (Table 69) or 93.61% of the total landings. The average catch per trip was 50 tons.

Table 67. Number of Vessels, Number of Trips, and Fishing Effort

	July	Aug.	Sept.	Oct.	Nov.	Total 1955	Total 1954
Number of vessels	3	11	15	8	8	16	11
Number of trips	4	23	34	14	8	83	43
Fishing effort (1000 F.H. × H.P.)	228	537	1167	477	443	2852	1464

Table 68. The Total Yields

	Species	Tons	‰
Pelagic	Herring	4,130	936
,,	Mackerel	7	2
,,	Others	2	
Demersal	Whiting	154	
,,	Saithe	32	
,,	Cod	31	62
,,	Dogfish, etc.	22	
,,	Others	34	
Total pelagic species		4,139	938
Total demersal species		273	62
Grand Total		4,412	1,000

Table 69. The Yields of Herring (Otter-Trawl)

Months	Total catch (tons)	Catch per trip (tons)
July	100	25
August	1386	60
September	1663	49
October	757	54
November	224	28
Total 1955	4130	50
Total 1954	2251	52

Table 70. Length, Weight, and Sex (‰)

Cm.	Aug.	Sept.	Oct.	Average
32	6	3	—	3
31	19	23	6	18
30	56	44	25	42
29	250	194	113	188
28	**356**	**203**	188	**236**
27	144	168	144	156
26	113	171	**244**	174
25	31	125	181	116
24	19	46	87	50
23	6	14	12	12
22	—	6	—	3
21	—	3	—	2
Total	1000	1000	1000	1000
Average length, mm.				276
Mode				28
Average weight, g.				180
Males, ‰				544

Table 71. Stages of Maturity and Intestinal Fat (‰)

Stages of Maturity

Stages	Aug.	Sept.	Oct.	Average
I	—	—	6	2
II	—	17	—	9
III	294	122	13	137
IV	**506**	**525**	175	**436**
V	181	336	**800**	410
VI	—	—	—	—
VII	—	—	—	—
VIII—II	19	—	6	6
Total	1000	1000	1000	1000

Intestinal Fat

Quantity	Aug.	Sept.	Oct.	Average
0	6	11	87	29
1	256	441	**763**	474
+	**707**	**525**	150	**478**
M	31	23	—	19
Total	1000	1000	1000	1000

3. The herring stock

The material investigated consisted of 8 samples comprising 665 herrings. They were collected in August (160), September (345), and October (160).

Table 72. Age Distribution (‰), N = 439

Age	Year-class	Aug.	Sept.	Oct.	Average
3	1952	7	33	61	30
4	1951	98	**267**	**394**	**235**
5	1950	211	163	197	182
6	1949	**240**	196	121	198
7	1948	211	163	121	171
8	1947	158	96	91	114
9	1946	15	41	15	30
10	1945	30	33	—	27
>10	<1945	30	8	—	13
Total		1000	1000	1000	1000

Table 73. Average Lengths by Age and Value of L_1 (mm.)

Brood	Lengths	L_1
1952	241	122
1951	261	116
1950	273	110
1949	285	121
1948	290	123
1947	294	125
1946	302	121
1945	303	124
<1945	312	106
Average ...	279	118

Table 70 shows the size distribution of the herring from month to month during the season. The average weight and the number of males (‰) was also recorded. The average length of the fish was 276 mm. and the average weight 180 g.

As to maturity it is evident from Table 71 that stage IV was predominant during August and September and stage V during October.

Table 74. Number of Vertebrae (‰) by Months and by Maturity Stages

VS	Aug.	Sept.	Oct.	Aver.	Stages	Aver. VS
55	19	9	19	14	I	58.000
56	336	228	252	259	II	56.500
57	**510**	**639**	**610**	**601**	III	56.828
58	135	121	119	124	IV	56.877
59	—	3	—	2	V	56.815
Total	1000	1000	1000	1000	VI	—
Average ...	56.761	56.882	56.830	56.840	VII	—
					VIII–II	56.500
					Mean	56.840

Table 75. Keeled Scales (K_2) in ‰

K_2	Aug.	Sept.	Oct.	Average
17	6	—	6	3
16	87	96	57	84
15	419	**428**	**494**	**442**
14	**444**	422	380	417
13	44	51	63	52
12	—	3	—	2
Total	1000	1000	1000	1000
Average	14.569	14.563	14.563	14.564

The age composition of the catches is shown in Table 72. The average lengths by age and the value of L_1 is given in Table 73.

A survey of the number of vertebrae (VS) is given in Table 74. The average figure for the whole season was found to be 56.840.

Finally Table 75 gives the number of keeled scales (K_2) by months. The average number for the whole season was 14.564.

CH. GILIS

C. The Skagerak, Kattegat, Belt Sea, and Baltic

YOUNG STAGES

Larvae in the Kattegat and the Belt Sea

Fishing with the 2 m. ring-net in the Kattegat in April, May, and June and in the Belt Sea in May and June produced small numbers of herring larvae, but, using the same net in October near Sprogø in the Great Belt and near Reersø in the northern part of the Belt Sea, proportionately more newly hatched larvae were found than in the previous years. As has already been mentioned in the *Annales Biologiques*, the autumn herring has for many years been very scarce, but (as predicted in the Ann. Biol. for 1954, from the abundance of Belt Sea autumn herring in the commercial catches of young herring) a larger fishery for spawning herring than for many years took place in the Belt Sea in 1955, and this was concentrated mainly in the above-mentioned localities. Also in the Kattegat, proportionately many newly hatched larvae were found in October north of Læsø.

Aa. J. C. Jensen

COMMERCIAL FISH

Small Immature Herring

(Tables 76 and 77)

Skagerak and northern Kattegat

The racial characters of the samples investigated are shown in Table 76. It is seen that most of the herring were autumn spawners from the western North Sea, and they seem to originate from nearly all parts of this region, from off Scotland to the English Channel except from those herring races from the Scottish coast with a very high K_2.

Winter-spawning herring from the northern Kattegat were found unmixed in one sample on 6. October, but they, or the related Scottish or Norwegian winter (or spring) herring, seem to constitute a part of several samples with a high number of vertebrae and low number of keeled scales.

Kattegat coastal winter spawners constitute all or nearly all of the larger herring in a sample taken on 28. February and in a sample of comparatively small herring dated 4. April.

Table 76. Racial Characters of 0- and 1-ringed Herring caught by Trawl in the Skagerak-Kattegat, Limfjord, Belts, and Baltic in 1955

Locality	Date	Number of samples	Winter-rings	Length, cm.	V.S.	Nos. invest.	V.P.	K_2	Nos. invest.
N. Kattegat–N. of Hirtshals	18. 1.–28. 2.	5	0	10–17	56.51	543	23.75	14.81	491
N. Kattegat–N. of Hirtshals	1. 2.–28. 2.	2	0	14–17	56.73	95	23.76	14.80	125
E. of Læsø	4. 4.	1	0	9–14	56.23	160	23.86	15.2	19
N. of Hirtshals	6. 10.	1	0	12–15	56.71	93	24.03	14.11	53
N. Kattegat–N. of Hirtshals	14. 9.–19. 12.	11	0	8–16	56.52	1721	24.03	14.42	862
N. Kattegat–N. of Hirtshals	18. 11.–23. 11.	3	0	7–10	—	0	—	14.69	181
N. Kattegat–N. of Hirtshals	16. 11.–22. 11.	4	0	11–17	—	0	—	14.46	217
N. of Hirtshals	17. 1.	1	1+	19–25	56.61	102	23,91	14.63	102
N. of Skagen	1. 2.	1	1	18–24	56.54	57	23.61	14.75	57
E. of Læsø	28. 2.	1	1	16–21	56.33	133	23.83	14.71	123
N. of Hirtshals	20. 4.	1	1+	18–24	56.60	174	23.92	14.49	152
E. of Skagen–N. of Hirtshals	18. 7.–21. 9.	2	1+	16–24	56.53	127	23.81	14.63	88
N. of Skagen	14. 9.–19. 12.	3	1+	16–26	56.82	125	23.99	14.65	126
Limfjord	5. 1.– 1. 2.	3	0	7–14	55.93	153	23.60	14.06	144
Limfjord	7. 10.	1	0	9–13	56.41	183	23.94	—	—
N. of Seeland	7. 3.	1	0	10–15	56.43	176	23.89	14.51	180
Aarhus bay–N. of Fyn	30. 3.– 1. 8.	2	0	9–18	56.07	225	23.80	14.16	58
Great Belt	28. 3.	1	0	8–12	55.70	107	23.50	13.88	86
Great Belt	28. 3.	1	0	13–16	55.96	78	23.77	14.34	85
Great Belt	9. 8.	1	0	9–11	56.24	174	24.64	—	0
Great Belt	25. 8.–25. 10.	2	0	8–13	56.14	345	24.54	—	0
Great Belt–Aarhus bay	16. 8.–27. 12.	15	0	9–17	55.78	2636	24.73	14.23	1631
N. of Seeland	15. 11.	1	0	11–16	55.92	184	24.62	14.39	181
Aarhus bay	30. 3.	1	1+	18–25	55.75	145	23.72	14.08	138
Little Belt	24. 1.–21. 3.	3	0	7–17	55.66	467	23.62	14.04	285
Little Belt	24. 10.–19. 12.	4	0	9–17	55.58	796	24.65	14.11	676
E. of Bornholm	9. 3.	1	0	11–18	55.45	304	23.46	14.23	209
E. of Bornholm	9. 3.	1	1	18–22	55.47	73	23.60	14.13	69

Table 77. Racial Characters of Herring caught for Consumption in the Skagerak, Kattegat, Belt Sea, and Baltic in 1955

D = Drift-net, P = Pound-net, T = Trawl

Locality	Date	Gear	Maturity	Length, cm. Mean	Length, cm. Range	Winter-rings	V.S.	Nos. invest.	V.P.	K_2	Nos. invest.
N. of Hirtshals.....	20. 4., 4. 5.	T	I, II, III	21	17–27	1–5	56.58	254	23.90	14.53	218
			VII, VIII	28	23–31	2–12	56.60	114	23.97	14.46	113
Skagen–Hirtshals ..	17. 11., 24. 11.	T	I, II, III	26	22–28	1–5	56.66	47	23.94	14.38	47
			IV, V	29	23–31	2–9	56.81	106	24.28	14.87	101
			VII, VIII	29	25–31	2–9	56.32	31	24.39	14.94	31
At North Seeland ..	3. 5.	P	II, III	22	19–24	2–4	55.81	85	23.69	13.96	83
			IV–VIII	24	20–28	2–6	55.80	88	23.52	14.07	85
At North Seeland ..	20. 9., 11. 10.	D	I, II, III	24	20–26	1–2	55.85	53	23.63	14.25	51
			IV, V, VI	23	20–28	1–5	55.72	206	24.62	14.40	206
S.W. of Fyn.....	5. 5.	P	I–VIII	26	21–29	2–8	55.92	166	23.48	14.31	163
E. of Bornholm ...	10. 11.	D	I, II, III	22	17–21	1–4	55.50	28	23.50	14.32	28
			IV–V	24	21–30	2–5	55.55	49	23.57	14.48	48
			VIII	23	20–25	2–7	55.48	101	23.79	14.10	97

The Limfjord

Three samples in January—February of herrings about 10 cm. long were Limfjord spring spawners and one sample in October were North Sea autumn spawners.

The southern Kattegat

One sample of fish about 13 cm. long in March consisted mainly of North Sea autumn spawners, and one of the same length in November was of coastal autumn spawners from this area or from the northern Belt Sea (Table 77).

The Belt Sea

Most of the catches of small herring consisted of local autumn spawners. Their length in August was about 10—11 cm., and in December about 14 cm. In a catch on 28. March the herring of 8—12 cm. in length were Belt Sea spring spawners, while those of 13—16 cm. were Belt Sea autumn spawners. The 18—25 cm. herring caught in Aarhus bay in March were found to be Belt Sea spring spawners, as were the smallest ones in a sample from the Great Belt in April. In a sample from Aarhus bay on 9. August the herring were Kobbergrund herring from the Kattegat. Kattegat coastal autumn herring were found in a catch in Vejle Fjord on 25. August and also in one from the same region on 25. October.

From the Little Belt four samples were investigated in October and December. The herring there were local autumn spawners (comp. Table 77).

It is seen that Belt Sea autumn spawners dominate the catches, and in 1956 and 1957 they will give the basis for an increasing autumn herring fishery in this region.

Adult Herring

From the Skagerak a sample in March consisted of immature and mature Norwegian spring spawners (Vårsild). A sample in May proved to be autumn spawners from the northern North Sea, which have a comparatively low K_2. A November sample consisted of maturing Norwegian spring herring. Mature herring caught in May at North Seeland were coastal spring spawners from the southern Kattegat or Belt Sea, and mature herring caught at the same place in October were autumn spawners from the same region.

From Bornholm a sample was investigated in November. A little more than the half of the herrings were recovering Baltic autumn spawners, and the rest were immature and maturing Baltic spring spawners.

Aa. J. C. Jensen

The Herring in the North-East Baltic

Judging from the quantitative estimation of Baltic herring larvae and the catches of the young stages, the 1954 spring brood seems to be of moderate strength and the 1955 brood appears to be abundant.

The catches of Baltic herrings in the Gulf of Riga in 1955 were mainly composed of two-year-olds and four-year-olds of the rich broods of 1951 and 1953 respectively, while in the Gulf of Finland, four-year-olds predominated. The rate of growth of the Baltic herring is slower in the Gulf of Finland than it is in the more southern parts, but the fluctuations in brood strength are the same in both areas.

One third of the trawl catches of these Baltic herrings taken to the westward of Saaremaa and

Hiiumaa, was composed of six-year-old fish of the abundant 1949 year-class.

During the pre-spawning season, Baltic herrings in these areas were found to be concentrated at a depth of 70 to 90 metres and the density of these concentrations decreased towards the shore. By May the shoals reached maximum density and by the end of the month all the fish had moved to the spawning grounds.

It was found that during diurnal migrations the upper limit of the Baltic shoals depended on the temperature of the water, and also that Baltic herrings do not appear in water whose temperature is lower than 1.5°C. The upper level of the shoals was found to be at 30—45 m. at night in the month of March, 28—40 m. in the first half of April, 18—35 m. at the end of April, and 10 m. to the surface in May.

L. Rannak

Sardine

COMMERCIAL FISH

Polish Investigations on the Sprat

The material was collected in order to investigate the morphological features of the sprat from Gdansk Bay and came from catches taken by bottom trawl. Table 1 shows the length distribution and the age composition of the stock in different periods of 1955.

Table 1. Length and Age (‰)

	Length				Age			
cm.	Jan.–March Winter	April–July Spawning	Sept.–Dec. Autumn	Year-class	Age	Jan.–March Winter	April–July Spawning	Sept.–Dec. Autumn
15	6	30	5	1949	6	29	64	17
14	61	181	33	1950	5	75	127	
13	134	264	204	1951	4	103	146	57
12	326	349	438	1952	3	198	234	108
11	350	157	261	1953	2	506	414	577
10	46	13	40	1954	1	89	15	223
9	59	4	3	1955	0	—	—	18
8	17	2	10					
7	1	—	6					
Total	1000	1000	1000			1000	1000	1000

The greatest part of the catches consisted, throughout the year, of the 1953 year-class. Older fish, the 1951 and 1952 year-classes, contributed, however, considerably to the yields during the winter and in the spawning period, and periodically, in the spawning period, even the 1950 year-class.

It is evident that the older age-groups disappeared partly during the autumn, and that the number of one-year-old fish increased proportionately at the same time. Finally, the O-group entered into the stock.

J. Elwertowski

Scombriform Fish

COMMERCIAL FISH

Tagging Experiments with Mackerel in the Skagerak in 1955

Tagging experiments with mackerel were continued during the summer of 1955. The experiments were carried out both in the outer skerries of western Norway and in the Skagerak off Arendal.

Mackerel have been tagged in fjords and in the outer skerries of western Norway since 1950 (cf. REVHEIM, Ann. Biol., VIII), but it was thought desirable to tag them in offshore waters also, in particular, in the Skagerak off the south-eastern coast of Norway, where there is an important fishery for mature mackerel in early summer.

We had an opportunity of extending our experiments to this district in 1954 and succeeded in tagging 1739 fish in two localities, viz., 5 to 15 nautical miles south-east of Arendal, and 10—15 miles south-west of Ferder. The mackerel tagged were caught by trolling and handled carefully as previously described (Ann. Biol., XI). Up to 20. September 1954 22 fish have been recaptured, i. e., 1.2% of those tagged. The percentage of recaptures is considerably smaller than that in the experiments in western Norway (Ann. Biol., XI); at present it is impossible to say whether this is to some extent due to the fact that the fish were caught in a different way, but evidently the fishing intensity in coastal waters is different from that in the open sea, just as the behaviour of the mackerel in the fjords and skerries differs from that in the open sea.

The total recaptures in the Skagerak experiments 1954 are shown in Figure 1. The results obtained were sufficiently interesting to warrant the continuation of mackerel tagging in the Skagerak, and between 6. and 10. June 1955, 1368 fish were tagged in a locality 3—15 nautical miles

Figure 1. Tagging experiments in the Skagerak 1954.
Open symbols: tagging localities.
Black symbols: localities of recapture.

south-east of Arendal, i. e., in approximately the same locality as the year before. The fish tagged were caught by trolling and handled as before, and the vitality of the fish marked was quite satisfactory.

Since 1952 only tags of white Alcathene film have been used; these are attached dorsally by a loop of nylon thread. In 1955, however, we changed over to yellow Alcathene film, as the yellow colour is more easily noticed by the fishermen working on the fish.

Comparing the two Skagerak experiments, we may see that the percentage of recaptures is about the same in both cases, i. e., 1.2% in 1954 and about 1% in 1955. The recaptures from the 1955

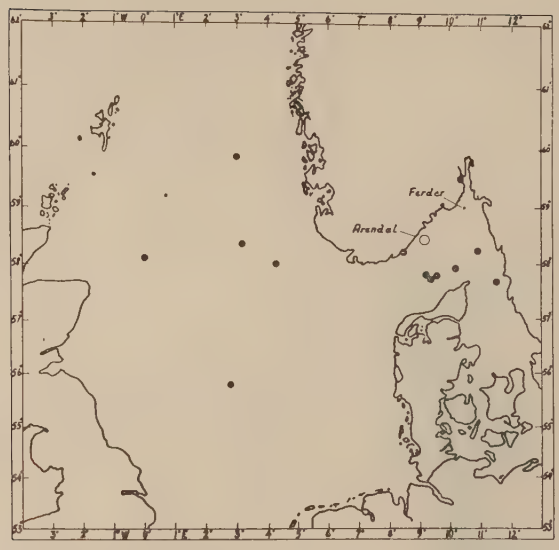


Figure 2. Tagging experiments in the Skagerak in 1955.
Open symbol: tagging locality.
Black symbols: localities of recapture.

Skagerak experiments are plotted in the chart, Figure 2. Comparison with Figure 1 shows that the recapture positions are more or less the same as in the 1954 experiments. This may be due either to the fact that the recaptures were made on the grounds in the Skagerak and North Sea commonly fished, or to the fact that each year after spawning the mackerel leave the Norwegian coasts and migrate to these localities.

The dates on which the tagged fish were retaken in the Kattegat, Skagerak, and North Sea in 1955 suggest that in the majority of cases the fish longest at liberty were retaken westward of the position of liberation. Recaptures may be made in these localities in winter also, and it is well known that large catches of mackerel may be taken in this district during the winter months.

Table 1. Tagging Experiments in the Skagerak, 23. May—10. June 1954 and 6. to 10. June 1955

Month of recapture	Locality: Kattegat 1954	Kattegat 1955	Skagerak 1954	Skagerak 1955	North Sea 1954	North Sea 1955
June	—	—	4	3	—	—
July	1	1	1	1	1	—
August	1	—	4	1	5	1
September	1	—	2	—	2	2
October	—	—	—	2	—	3

Table 1 shows the monthly recaptures in the Kattegat, Skagerak, and North Sea in the Skagerak experiments in 1954—55.

A. Revheim

Thunnidae et Cybiidae de S. Tomé et Principe

En plus de l'espèce *Cybium tritor*, signalée par B. Osório (1892) sous les noms de *C. tritor* (»Cavala«) et *C. maculatum* (»Serra«), respectivement dans la mer équatoriale des îles Principe et S. Tomé, il existe encore, dans ces eaux, trois autres espèces: *Scomber colias* (»Peixe-chuva«), *Euthynnus alleteratus* (»Atum«, »Fule-fule«) et *Neothunnus albacora* (»Atum«). Le nom ancien »Alvacor« (M. Ribeiro Ferreira, 1877), correspondant probablement à *N. albacora*, tomba en désuétude.

A notre connaissance, ces trois espèces n'avaient pas été signalées auparavant dans la littérature scientifique comme se trouvant à ces parages, bien que *S. colias* et *N. albacora* soient depuis longtemps connues dans certaines régions au sud de l'Equateur.

Quelques observations ont été faites en ce qui concerne particulièrement *Cybium tritor*, *Euthynnus alleteratus* et *Neothunnus albacora*.

I. Conditions océanographiques

Les observations faites au mois d'Octobre 1955 ont montré que la température en surface varie entre 24.2° et 24.9° C., et la salinité entre 33.84‰ et 34.33‰.

II. Pêche indigène

Cybium tritor (»Serra«): La pêche, faite à la ligne traînante pendant toute l'année, est assez profitable surtout aux alentours de l'île Principe. Un système européen de pêche comparable à celui utilisé par les thoniers donnerait probablement les meilleurs résultats.

Euthynnus alleteratus (»Fule-fule«): La pêche est faite dans les eaux de surface, en entourant les bancs au moyen de bateaux indigènes et de filets verticaux, les poissons étant engagés dans leurs mailles et ensuite pris par les pêcheurs.

L'apparition de *E. alleteratus* dans les eaux de surface se fait au mois d'Octobre.

Neothunnus albacora (»Atum«): La pêche est exercée pendant toute l'année à S. Tomé. Elle est surtout faite par les pêcheurs de Aldeia das Neves et d'autres localités au N. et N.O. de l'île,

au moyen d'une ligne de profondeur (»linha de fundo«), dont la longueur varie jusqu'à une centaine de mètres environ.

Une autre façon de pêcher le thon consiste dans l'emploi d'un appât mort (»sardinha«, une *Sardinella*), pour attirer le poisson et d'une ligne non plombée, »linha flutuante«, amorcée.

Les mois depuis Octobre à Février sont les plus intéressants pour la pêche, un plus grand nombre de poissons de cette espèce étant présent pendant cette période.

III. Maturation sexuelle

1. *Cybium tritor*. L'étude histologique des gonades de deux femelles a donné les résultats suivants:—

Au mois d'Août, deux femelles (longueur totale, respectivement, 690 et 720 mm.; poids du corps, respectivement, 2,800 et 3,300 g.) présentaient, l'une, la plus petite, des oocytes en vitellogénèse avancée, et l'autre des oocytes de grande taille (600 μ) et des follicules vides, en cours de comblement, aux extrémités des lamelles ovigères.

Il est à noter que F. Frade et E. Postel (1955) ont reconnu que, dans la mer du Sénégal, la période de reproduction de cette espèce s'échelonne de Juin à Septembre—Octobre. Postel (1955) est d'avis que *C. tritor*, en Avril, est déjà en maturation sexuelle, la période de la plus grande activité reproductive étant au mois de Juin.

A S. Tomé, fin d'Août, il se trouvent déjà des individus en maturation et même en commencement de ponte, ce qui ne s'écarte pas beaucoup de ce qui a été observé au Sénégal.

2. *Euthynnus alleteratus*. Aux mois de Septembre et Octobre, des observations ont été faites concernant le poids total et le poids des gonades, ayant en vue la détermination de l'indice gonosomatique (G.S.). L'analyse histologique des échantillons de gonades a donné une idée assez précise de l'état de la maturation sexuelle, à l'époque considérée, en concordance avec l'indication de l'indice gonosomatique, toutefois que des pesages ont pu être faites. Voici les résultats obtenus:—

Trois mâles (longueur totale: 550—600 mm.; G.S. = 2.3): vésicules à parois épaisses et spermiogénèse active; canaux remplis de spermatozoïdes.

Deux femelles (longueur totale: 500 mm. environ, G.S. = 2.9): oocytes de grande taille (600 μ), pour la plupart en autolyse.

Deux femelles (longueur totale: 455—525 mm.): encore des oocytes de grande taille et des follicules en oblitération, dénonçant une ponte récente.

Trois femelles (longueur totale: 490—540 mm.; G.S. = 3.5): oocytes de grande taille et des follicules en oblitération (signes de ponte).

Deux femelles (longueur totale: 510—530 mm.; G.S. = 2.6 et 3.6): oocytes de grande taille; follicules en oblitération et des signes d'atrésie.

Une femelle (longueur totale 510 mm.; G.S. = 1.7): oocytes de grande taille pour la plupart en atrésie, dénonçant une ponte terminée.

Il est évident que, dans la période qui commence vers la fin d'Octobre et s'étend à Novembre et Décembre (la pêche est exercée jusqu'au mois de Janvier), le *E. alleteratus* en mer de S. Tomé-Principe est en maturation sexuelle, des individus pris aux premiers jours de Décembre ont déjà terminé la ponte et la valeur de l'indice gonosomatique tombe de 3.6% à 1.7% environ.

Il est intéressant de signaler qu'au Sénégal (F. Frade et E. Postel, 1955) la ponte est faite depuis Juin à Octobre et se termine à l'époque où elle commence à S. Tomé-Principe.

En plus, Postel (1955) fait noter, que le maximum de la maturation, pour les mâles, se vérifie de Juin à Septembre, et, pour les femelles, de Juin à Août, période pendant laquelle la ponte est plus active.

3. *Neothunnus albacora*. Un seul mâle a été étudié au point de vue histologie des gonades; il avait les vésicules à parois épaisses, mais à spermiogénèse active, et les canaux remplis de spermatozoïdes.

Il est à noter que, d'après F. Frade et E. Postel (1955), *N. albacora* est en maturation sexuelle, au Sénégal, depuis Mai jusqu'à Septembre. Et Postel (1955) est d'avis que la ponte se situe probablement en Juin—Juillet.

F. Frade & F. Correia da Costa

Littérature

F. Frade & E. Postel. Rapp. et Proc.-Verb., **137**, pp. 33–5. 1955.

E. Postel. "Contribution à l'étude de la biologie de quelques Scombridae de l'Atlantique tropico-oriental". Tunis, 1955.

Shellfish

INTRODUCTION

Contributions have been received form H. Cole B. Havinga and P. Korringa (four papers).

Numerous communications on results of investigations carried out on shellfish in 1955 have been briefly mentioned in the Administrative Report from the Shellfish Committee.

B. Havinga

CRUSTACEA

The Stock of Shrimps *(Crangon vulgaris)* in the Dutch Coastal Waters

In *Annales Biologiques*, Vol. VII, 1950, I gave a review of statistical investigations on the landings of shrimps over a long series of years and on the catch per unit effort since 1946.

The purpose of these investigations was to obtain some information on the influence of the fishing on the stock, about which nothing is known. As the statistics of catch per unit effort included the years 1947—50 only, the figures were too few to enable any conclusion to be drawn about the influence of the fishing on the stock. I, therefore, decided to continue the collection of statistics per unit effort, and figures are now available for the period 1946 to 1954.

In Table 1 the landings of shrimps are shown in various districts of the Dutch fishing grounds. The landings of shrimps for human consumption and for drying are given separately, and the sum of both is added up. For most purposes it is safest

Table 1. Landings of Shrimps (in Tons) in various Districts in the Netherlands since 1916. For Human Consumption (Cons.), for Industrial Purposes (Ind.), and the Sum of both (C + I)

Year	Schelde Estuary			Rhine Estuary			Western Waddensea			Eastern Waddensea		
	Cons.	Ind.	C + I	Cons.	Ind.	C + I	Cons.	Ind.	C + I	Cons.	Ind.	C + I
1916—1920	2,354	—	—	850	86	936	3,035	—	—	—	—	—
1921—1925	2,029	—	—	997	54	1,051	2,246	—	—	—	—	—
1926—1930	2,041	1,988[1])	4,029	845	328	1,173	2,550	—	—	—	—	—
1931—1935	2,084	3,117	5,201	840	564	1,404	1,019[2])	—	—	—	—	—
1935	1,447	3,130	4,577	766	834	1,600	573	—	—	65	4,965	5,030
1936	1,817	8,128	9,945	758	1,556	2,314	410	—	—	56	10,092	10,148
1937	1,575	6,776	8,351	838	1 559	2 397	202	—	—	77	11,051	11,128
1938	1,643	3,256	4,899	1,012	1,104	2,116	299	—	—	87	8,241	8,328
1939	1,303	7,099	8,402	1,045	1,049	2,094	353	—	—	111	11,272	11,383
1946	1,097	12	1,109	451	49	500	573	206	779	406	2,029	2,435
1947	1,951	854	2,805	949	196	1,145	678	701	1,379	476	5,306	5,782
1948	1,400	180	1,580	1,045	104	1,149	645	289	934	675	2,765	3,440
1949	1,163	1,685	2,848	524	310	834	604	280	884	682	2,602	3,284
1950	1,188	1,367	2,555	542	327	869	583	863	1,446	675	4,712	5,387
1951	1,394	1,818	3,212	525	319	844	976	1,539	2,515	1,078	4,992	6,070
1952	1,532	1,946	3,478	458	292	750	1,332	2,881	4,213	519	4,071	4,590
1953	1,297	1,775	3,072	285	235	520	1,355	3,478	4,833	748	6,836	7,584
1954	901	1,075	1,976	275	268	563	1,635	3,122	4,757	974	5,662	6,636
1955	1,938	3,205	5,143	318	219	537	2,341	4,365	6,706	1,227	5,306	6,533

[1]) For the years 1929 and 1930. [2]) These figures include also the landings in the Zuiderzee up to 1931.

to consider this sum, because the sorting of shrimps for consumption and for drying sometimes depends on the selling facilities of shrimps for consumption.

The table shows a great difference in the pre- and post-war catches in the estuaries of the rivers Schelde and Rhine. As an average the post-war landings show a decrease to about one half or less of the pre-war figures.

It is impossible to compare the fishing capacity of the fleets and the intensity of fishing in both periods. The ships have become larger and more powerful in the post-war years, but their numbers have diminished, and, in addition, the larger vessels are sometimes used for fishing when this is considered more profitable. It is not supposed, however, that the fishing intensity has decreased to the same degree as the catches, which would mean that the stocks in these districts have decreased in comparison with pre-war years.

The figures for the Waddensea are incomplete, and conditions have changed owing to the closure of the Zuiderzee and other reclamation works.

Unfortunately figures for the catch per unit effort are not available for the pre-war period, and it is thus impossible to obtain further data for a comparison of the post- and pre-war stock. Figure 1 shows the mean catch per day's absence for a whole year since 1946. Each figure is based on the catches of 6 ships, 3 large and 3 small ones. The diagrams do not show high catches immediately after the war, therefore, they do not indicate that the stock has increased considerably during the war.

The graphs for the estuary of the western Schelde and for the IJmuiden and Texel grounds show a distinct decline in these 9 years; in the estuary of the Rhine the ships used for the statistics have increased their power by more than 50% which fact complicates computation; if this change had not been made a decrease in the catches would also have been probable.

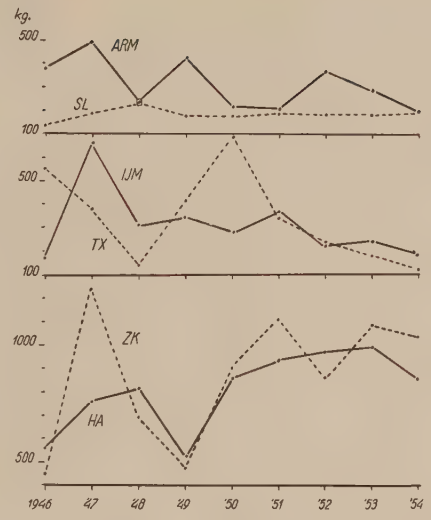


Figure 1. Catch of shrimps (for consumption and for drying combined) per vessel per day's absence in various districts. ARM, estuary of Schelde; SL, estuaries of Rhine and Meuse; IJM, Dutch coast near IJmuiden; TX, area near the Isle of Texel; HA, western and ZK, eastern part of the Dutch Waddensea.

In both districts of the Waddensea the graphs show a distinct increase in catch per unit effort.

The following conclusions may be drawn from the investigations:-

1) The post-war stocks of shrimps are in some districts smaller than they were for a long series of pre-war years;

2) The diminished fishing intensity during the war has not caused an increase of the stock;

3) In the post-war years the stock has decreased in the estuaries of the rivers Schelde and Rhine and along the Dutch North Sea coast; this observation does not apply to the Dutch Waddensea.

B. Havinga

MOLLUSCA

Oyster

English Investigations

Production of oyster larvae in the rivers Blackwater, Crouch, and Roach was very high but the numbers surviving to settlement were poor and comparable with 1953 and 1954. Unusually high mortalities of newly liberated larvae occurred (on 8. August, a 100 l. sample from the Crouch yielded 6,000 larvae of which 97% were dead or dying). Losses did not appear to be directly related to the unusually high temperature experienced. In the Colne larval numbers were always low but the percentage surviving to settlement was proportionately much greater than in the other three rivers.

Flagellate production was relatively high throughout the season being at its best in the Colne. The populations were different from those previously encountered. The unusual clarity of the water and the high temperatures might have accounted for this.

DDT sprayed collectors not only yielded twice as many oyster spat as controls but the spat themselves, because of lack of competition from dense *Elminius* populations, grew more rapidly. They were 40% bigger than those on the control collectors at the end of $2^1/_2$ months. On shells too the DDT appeared to have a beneficial effect.

In Essex more *Urosalpinx cenerea* have been destroyed. This is attributable to the extended use of curved roofing tiles as traps. Oyster farmers have been advised of their efficiency and some are already in use. Spawn of *Urosalpinx* can overwinter in the field. This emphasizes the need for care in moving oysters from place to place even in winter. Methods of destroying the spawn are being investigated.

Heavy settlement of young individuals of *Asterias rubens* has occurred in the lower Crouch. These have virtually cleared the barnacles from this heavily infected area but have destroyed very few spat.

Crepidula fornicata has not extended its recorded range during the year and the rate of multiplication of the pest in Cornwall is less than anticipated. On the east coast the spatfall was moderate.

Serious shell disease has been found amongst Portuguese oysters at West Mersea. The incidence is similar to that amongst native oysters.

The unusually high temperatures in the Conway breeding tanks depressed the production of larvae. Spatfall only occurred in the tank which was partially shaded. A similar phenomenon was observed in the last hot summer (1949).

In the Menai Straits oysters kept in shallow pools where they were constantly covered by water grew far better, at all levels, than those exposed on the shore.

Ciliary motion studies

Oyster larvae can now be immobilized and the feeding process studied in detail. Feeding efficiency is very low. Food intake is directly related to temperature but unaffected by salinity between 20 and $32^0/_{00}$ at 20°C.

A method of continuously recording shell movement and pumping rate of oysters and mussels has been developed. Oysters pump steadily whilst submerged but the rate increases logarithmically with rising temperature. Pseudo-defaecation occurs frequently in turbid water. This interrupts pumping and reduces feeding time.

Mussels do not feed and pump continuously. There is little interruption of pumping during pseudo-defaecation which occurs at frequent intervals.

H. A. Cole

Larvae and Spatfall of Oysters in the Oosterschelde (Holland) in 1955

Owing to unusually low water temperatures during the summer, oyster-spat production was a complete failure in 1954. Consequently the oystermen looked forward with great interest to the spatfall of the 1955 season. To assist them in their efforts to produce a good crop of spat, we continued, in 1955, our observations on the number and size of oyster larvae in the Oosterschelde. The methods used in collecting samples of 100 l. of water and in counting and measuring the larvae in the samples have already been described. The samples were again collected at the Yersche Bank station in the centre of the basin of the Oosterschelde. Daily samples were taken at high slack water from 13. June to 27. June; twice-daily samples were taken at high slack and low slack water at the height of the season from 28. June to 12. August. From 13. August to 13. September daily samples were collected at high slack water. On Sundays it was impossible to collect plankton samples as our boats were idle in port. When two samples were taken in the course of a day, the average number of each size-group was computed for 100 l., and entered in the diagram (Figure 2).

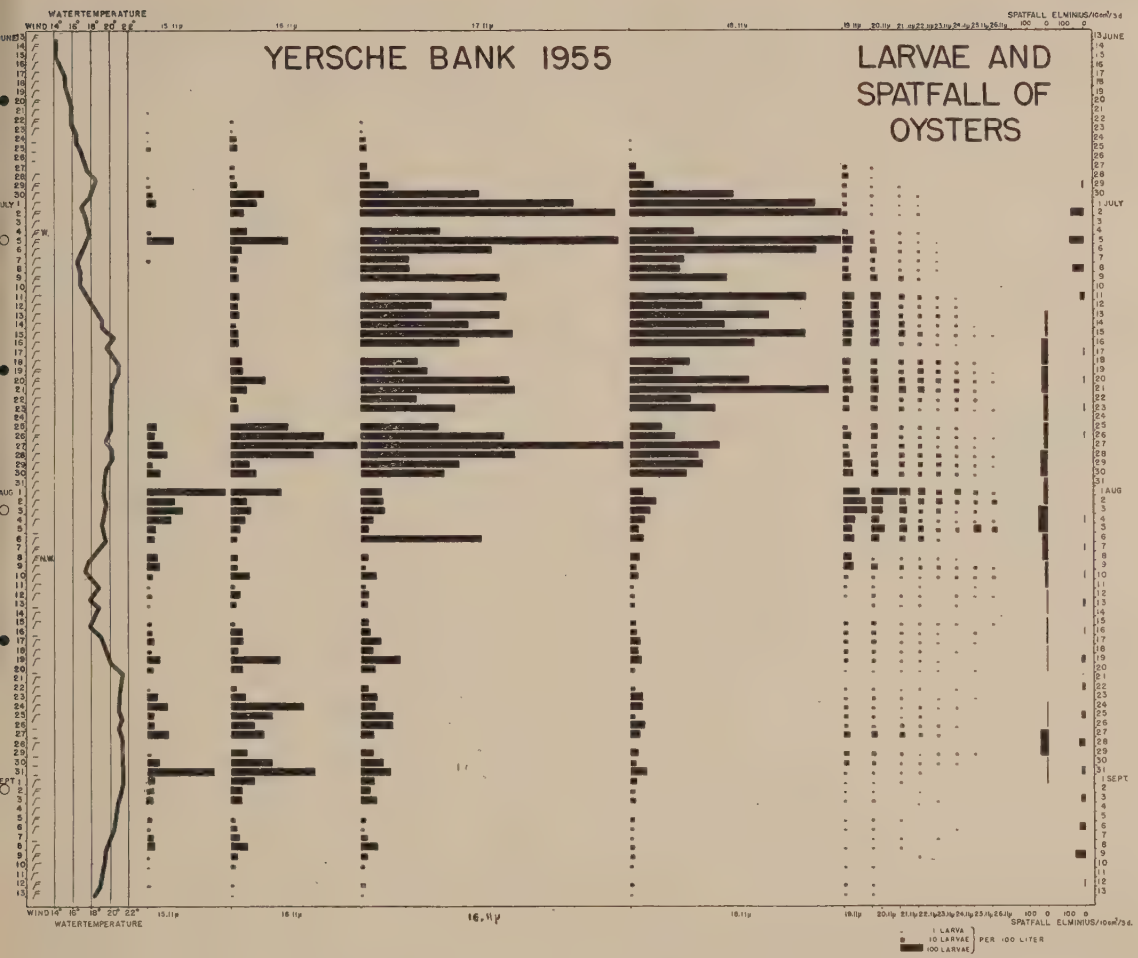


Figure 2

The intensity of setting was measured in the usual way by exposing 3 lime-coated glass slides, measuring 13 x 18 cm., at an angle of 45° in a concrete container for three days. The average number of the barnacle *Elminius modestus* DARWIN present on 10 cm². of the slides (5 cm². upper surface and 10 cm². lower surface) is also shown in Figure 2.

Our forecast bulletins, broadcast also by radio, were as follows: Owing to the fair prospects, based on the steadily increasing stock and on the good condition of the oysters, an ample production of larvae could be predicted, which could lead to a disappointing setting of spat only if the water temperatures remained below 18° C. for a long period. According to the lunar periodicity a peak in the production of larvae was to be expected about 30. June. In the week beginning 12. June water temperatures were, however, as low as 14 to 15 °C., while 17° would have been the normal figure. As compared with former years no oyster larvae had been seen up to 20. June. Therefore it seemed doubtful whether the peak in larval production would appear on schedule, or perhaps a fortnight later. On 23. June the first few larvae were announced at a water temperature of 16° C. On 27. June a gradual increase in water temperature was recorded, but the number of larvae was still of no practical importance. On 30. June a considerable increase in the number of oyster larvae was reported, while the water temperature had reached the desired 18° level, so that a slow development of the larvae seemed possible. The bulletin issued on 2. July reported well over 1000 larvae per litre of water. Evidently the annual peak came in time notwithstanding the unusually cold Junel As water temperatures were barely 18° C. larva.

development was slow, umbo larvae were rare and "mature" larvae completely absent, no setting was yet to be expected. More larvae could, however, be expected to appear in the next weeks. On 6. July the water temperature had fallen, which brought larval development to a complete standstill. No setting could be expected in the next few days, though the total number of larvae was still very high. Similar prospects were issued on 9. July when the water temperature had fallen to 17°C., and the number of larvae, though still large, showed a tendency to decrease. A rapid amelioration in weather conditions made it possible to state, on 12. July, that water temperatures had exceeded the 18° level. Larval development was resumed immediately and the first setting might soon be expected. If the weather remained favourable setting could reach a commercial level in the week opening on 17. July. The favourable outlook was confirmed on 15. and 19. July, the number of umbo and "mature" larvae increasing steadily. On 23. July conditions were still favourable and prospects for a setting of commercial importance were bright. On 29. July the outlook for setting remained favourable, water temperature was fairly high and larvae were plentiful; still, larval development was not so good as the water temperature seemed to promise. The last tiles were immersed early in August and it was only for scientific reasons that observations were continued. On 16. August the last bulletin was issued in which it was said that spatfall had come to an end, the number of larvae having dropped below 100 per 100 l. of water.

The diagram (Fig. 2) shows that our forecasts were up to the actual facts. The total production of larvae was indeed great in 1955, exceeding slightly the figures for 1953 and 1954, commensurate with a further increase in the stock of oysters. This confirms our earlier conclusions that the total number of larvae produced is mainly determined by the size of the stock of parent oysters. Apparently there is in *Ostrea edulis*, at least in the Oosterschelde population, a very limited influence of year to year fluctuations in the number of eggs produced by the individual oysters. Contrarily, *Crassostrea virginica* shows enormous differences in productivity, dependent on their "condition" in early summer, which can be expressed in millimetre thickness of gonadal tissues.

As usual, July was the big month for larval production. In the Oosterschelde we never witnessed a general recurrence of spawning many weeks after the main season, as has been reported for other parts of *Ostrea edulis*' range, and for several other species of oysters. It is remarkable that water temperatures in the months preceding spawning exert such slight influence on the date when the larvae appear. We never experience a serious delay in spawning after an unusually cold winter and neither seems a cold spring to influence much the time of spawning. In 1955 the water temperatures in January were 1.3°C. below the normal, in February 0.5°, and in March even 2.6° lower than usual. April was about normal with 8.5°C., but May, with 11.8°, was some 1.5° too cold, and June, with 16.0°, was about 1.0° lower than an average year. Still, the peak in larval production did not appear much later than usual, at most incubation was somewhat prolonged by low water temperatures. The greatest numbers of larvae appeared from 30. June to 5. July, a few days later than might have been expected at higher temperatures. Diffuse peaks in larval production occurred thoughout July with a clear-cut peak on 27. July. This evidently is the lunar periodicity peak following the new moon on 19. July, a few days in advance, on account of the speeding up of incubation by high water temperatures (above 20°C.). It is rather peculiar that larvae produced in July were quite large, the 16.11 μ-group not becoming important until the end of July at fairly high water temperatures. The larvae produced in August were, as usual, smaller; the slowing up of larval development by low water temperatures is again very evident, but as soon as temperatures over 18°C. are recorded growth improves, finally resulting in a setting of commercial importance. But larval development in the second part of July was not so favourable as might have been expected from water temperatures alone. Evidently other factors — presumably the food factor — interfered here. Late in July the plankton sampled was typically animal, almost devoid of plant life, a fact often experienced after prolonged spells of fine and stable weather. The number of flagellates fluctuated throughout the spawning season from 1500 to 5000 per cm^3. with a rather sharp peak early in August. The rather sudden improvement in the development of the oyster larvae early in August, so conspicuous in the diagram (Fig. 2), may be ascribed to this peak.

In 1955 the spatfall was good from 15. July to about 10. August, the highest peak occurring about 4. August. A peak in setting, of short duration only measured as late as 28. August, was remarkable. It is very unusual to find a setting of that magnitude late in August. At that time there was

a slight increase in the number of umbo larvae, but barely enough for the setting observed.

Commercially the spatfall season of 1955 was a great success. Our bulletins prevented the oystermen from placing their collectors too early. In other years the immersion of the tiles is started in the last decade of June and reaches a peak when good setting prospects are announced. In 1955 no tiles were placed until 12. July, which is extremely late. The oystermen already feared a recurrence of the 1954 failure and intended to keep their tiles ashore as setting prospects remained very poor. Figure 2 shows that they were right in their precautions, not even a sprinkling of spat was found until 12. July. The majority of the tiles was immersed between 15. and 25. July, some as late as early August. Good setting occurred for weeks in succession, not interrupted by adverse weather. No silt being stirred up by strong winds, the tiles remained clean for quite a while and "fished" much longer than usual. At the end of the season most of the 3,000,000 tiles put out bore more than 100 oysters each, some up to 300. Even if the size of the spat was small, due to the late setting, feeding conditions were so good in the warm September that the spat had attained the normal diameter at the approach of winter. Mussel shells scattered as collectors (8700 m^3.) caught a good set of spat too. An average of 2 spat per shell was counted on many plots. As frost continued for weeks in February 1956 and ice was formed on an almost unprecedented scale there was reason to fear the worst, but after thawing it was found that only slight damage had been done. Since the ice had not piled up the tiles in their wintering pits, they had not been crushed and both spat and older oysters appeared to be quite strong at the end of winter.

The setting of the barnacle *Elminius* was almost negligible in the period from 12. July until late in August, and the tiny oyster spat did not suffer.

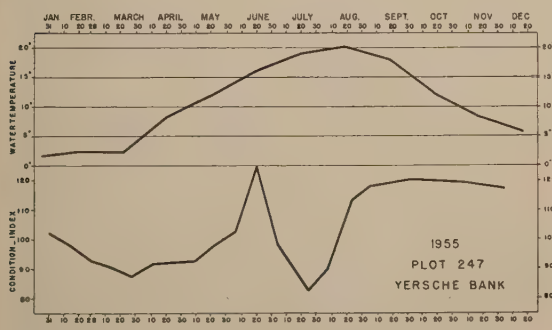


Figure 3

As the tiles were placed after 12. July the spat escaped the maximum setting of *Elminius* which occurred in the first week of July (see Figure 2).

P. Korringa

The Quality of Marketable Oysters from the Zealand Waters in 1955

The steadily increasing stock of oysters in the Oosterschelde, Holland, induced us to continue our observations on the quality of marketable oysters developed in the various districts of the Zealand waters. Again this quality has been expressed as a condition index measured at the end of the fattening season, in November and December 1955. Various hydrographical and biological factors, presumably associated with the growth and fattening of oysters, have been observed on a weekly basis throughout the year.

From one plot in the centre of the oyster district in the Basin of the Oosterschelde (i. e., plot 247 Yersche Bank) we have taken a series of samples throughout the year. The tendency of the condition index shown by these oysters (Fig. 3) is considered characteristic of the entire population, though minor aberrations will certainly have occurred. The graph shows a slow but gradual decline of the quality from January till late in March, a period in which the oysters do not feed appreciably. Though March was characterized by a very profuse phytoplankton development, the water temperature was still below 5°C. so the oysters could not take advantage of this development. With a rising water temperature the oysters began to recover, first slowly, but more rapidly, as soon as the 10°C. level had been passed. Late in May the condition index was about 100, in the middle of June it rose to over 120. The oysters were at that time "well-fished" from a biological point of view, though unfit for consumption, the gonads being full of spawn. A very steep drop in conditions occurred between June 20th and July 20th. This must without doubt be attributed to active spawning of practically all the oysters. It is amazing to see how fast the oysters recovered in the months of August and September of the year 1955. Evidently feeding conditions were optimal at that time. The height was reached late in September (condition index 120, indicates that the oysters were very good indeed). This time the connective tissues covering the intestines were bearing glycogen instead of eggs or sperm, which rendered the oysters attractive from the consumer's point of view. Very little change in condition has been observed during the

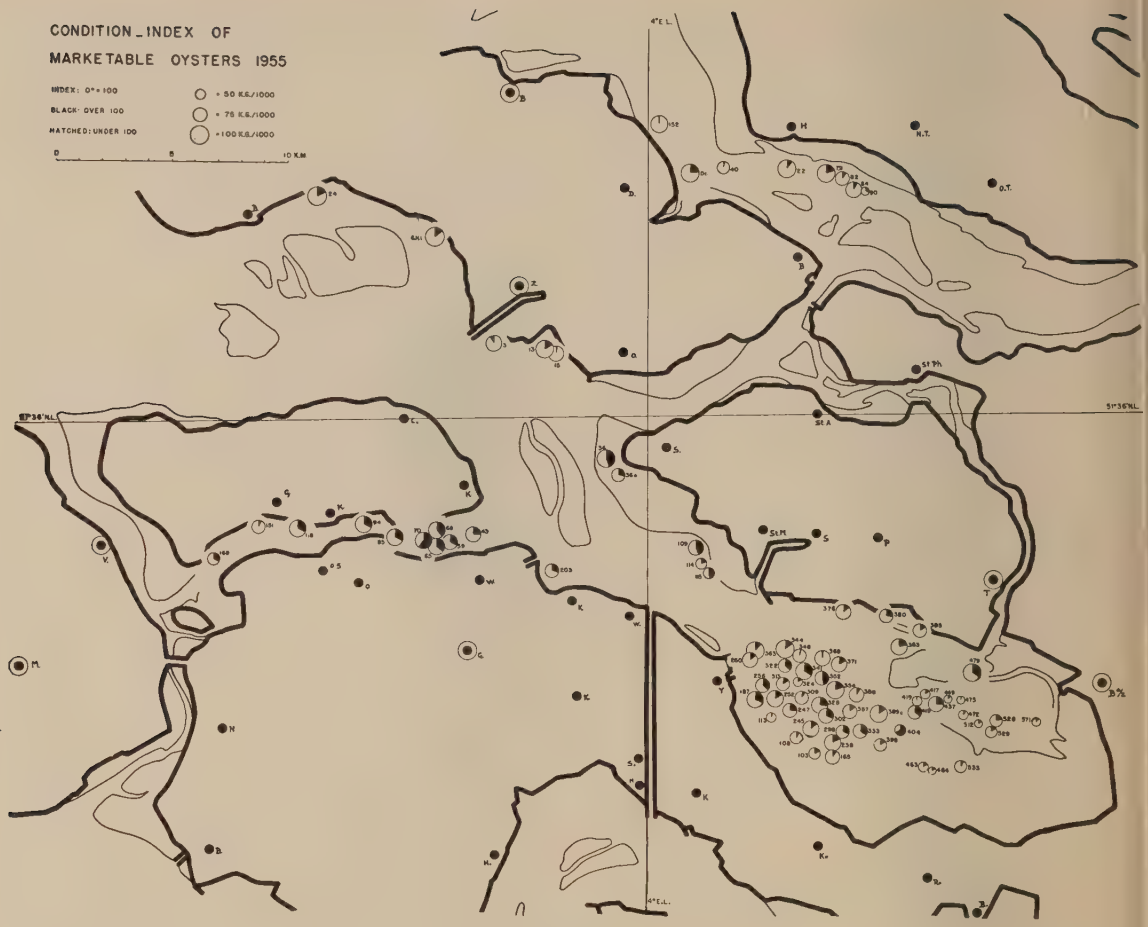


Figure 4

last three months of the year at the decreasing water temperature.

When the year 1954 was characterized as "propitious", because the quality of the marketable oysters in the Zealand waters left little to be desired, the year 1955 must be called "exceptionally good". Not only was the growth of the oysters better than in an average year, and the mortality rate during the summer months amazingly low, but corresponding with our observations on plot 247 (Fig. 3) the oystermen observed a rapid fattening in August and September, leading to an almost unprecedented level in early winter. The oysters were not only "fat" in nearly every district, but also "strong" throughout the winter, "hockley" oysters and "gapers" being rare, even after the prolonged cold spell in February 1956. I ascribe this tentatively to a very low occurrence of microscopical parasites.

Condition indices, measured in November and December 1955, have been charted (Fig. 4). Comparison with 1954 (Ann. Biol., XI, Fig. 3, p. 181) demonstrates clearly that the oysters were almost of perfect quality everywhere, samples with indices under 100 being rare. Even the oysters collected in the eastern part of the Oosterschelde (plot 417 and further east) and those from the shallower parts of the Yersche Bank (plot 165 and lower numbers) show rather high values, though these beds are never used for the production of marketable oysters. Growth of young oysters may be favourable there, but fattening can not

normally be expected on those plots. Again the oysters relaid for fattening in the Zandkreek (plots 43 to 168 incl.) were exceptionally good. The oystermen, however, were not satisfied with the results obtained on those grounds, for the difference in quality with the oysters grown in the Basin of the Oosterschelde was not great enough to make up for the much heavier losses which they always experience on the Zandkreek plots, where soft and shifting bottoms are a serious handicap. In some other areas west of Yerseke countless *Polydora* burrows made the shells of the oysters so brittle that they were difficult to market, despite their excellent meat quality and flavour.

In the Basin itself the differences in quality were not striking this year, though the tendency for the highest figures to be found in the central part of the Yersche Bank, fanning out from west to east, as recorded for 1954, and which accords with the general experience of the oystermen, seems to be of a constant character. The poor quality on plot 368 and 419-north accords with the opinion of the oystermen that these plots are too "sharp", i. e., are characterized by fast-moving sand grains for at least part of the tidal cycle.

Though we cannot yet say exactly which factors lead to excellent fattening of oysters, it will be expedient to record here the general trend of the hydrographical and biological conditions, derived from analysis of water samples taken on a weekly basis in the centre of the oyster district in the Basin of the Oosterschelde. Comparison with similar data for other years and other districts will no doubt reveal with greater precision the factors which are of paramount importance for the growth and fattening of oysters.

As appears from Table 4, added to the paper on *Mytilicola*, water temperatures in the Oosterschelde were greatly below the normal for the first half of 1955. In the second half, on the other hand, water temperatures were up to 2° C. above the normal. August, September and October, the most important months for oysters fattening, were well above the average. Salinity was quite low from late in January to early in May (25—27‰) much higher than the average in mid-summer (29 to 30‰ in June, July, and August), and for the remainder of the year it was remarkably constant (29‰), but slightly higher than the general average for these months (i. e., 28‰). Hours of sunshine, so important to the phyto-plankton development, were numerous in April and May, and again in August and September. July, August and September gave few days only with strong winds and rough sea. This may account for the lower turbidity of the water during the main fattening period, which in its turn will have facilitated the feeding of the oyster. In inorganic phosphate we measured 0.5 μg. at./l. from January till late in March, some 0.1 to 0.2 in April and May, 0.2 to 0.3 in July and August, 0.3 to 0.5 in September and October, and 0.6 to 0.8 in November and December. Though the total phosphorus figures did not remain constant throughout 1955 as they did in 1954, the fluctuations observed were not very great. On an average we recorded 1.05 μg. at./l. of which some 0.33 μg. at./l. appeared to belong to plankton and detritus, the remainder being either truly dissolved or in a very finely dispersed state. It is noteworthy that these figures are somewhat lower than those for 1954, slightly higher for the low-water samples than for the high-water ones, and showed minimum values in the period August/September (0.91 μg. at./l. and 0.29 μg. at./l. respectively) though oyster fattening was better in 1955 than in 1954, though high-water samples contained more phytoplankton than low-water samples, and though August and September were excellent for growth and fattening of the oysters. It is apparently not so very easy to use total phosphorus figures as a measure for the fertility of natural waters. In the period July-October some 6 mg. of $KMnO_4$ were necessary to break down the more labile organic matter in 1 litre of water, in November and December some 4 to 5 mg. only. On an average only 1 mg. could be ascribed to plankton, detritus, and other readily settling matter. The phytoplankton again showed considerable fluctuations in the course of the year. During the highest peak in phytoplankton production, in March 1955, we measured some 60 to 80 mg. chlorophyll per $m.^3$, of which only about $^1/_3$ could be collected with the closest woven bolting silk. Water temperatures were so low at that time that the oysters hardly filtered any water. In the period of important fattening, viz., in August and September, we noted that the flood water was appreciably richer in phytoplankton than the water over the oyster beds at low slack water: at high slack water we measured some 15 to 25 mg./$m.^3$ at low slack water some 10 to 15 mg./$m.^3$, of which $^1/_4$ to $^1/_3$ was located in organisms or particles big enough to be retained by the closest woven plankton silk. In October the chlorophyll content fell to some 10 mg./$m.^3$. In the important period August/October pigment figures were slightly higher than in the preceding year (on p. 182, line 16 from below of Ann. Biol., XI, the quantities

have erroneously been recorded as 1 to 2 mg. instead of 10 to 20 mg. chlorophyll per m.[3]). The numbers of flagellates fluctuated between 2000 and 10,000 per cm.[3] in August and September with an average of about 5000. These figures too are slightly higher than those of the preceding year.

It may be concluded from these observations that several factors tentatively associated with oyster fattening show indeed somewhat more propitious values in August, September, and October 1955 than in the corresponding period of the year 1954. As the analysis for 1955 covers the Basin of the Oosterschelde only, it is not yet possible to see why the quality of marketable oysters was generally so high in every district in 1955, whereas there were marked differences in 1954. We hope to collect data in more districts during the fattening season of 1956.

P. KORRINGA

Reference

KORRINGA, P., 1955. Ann. Biol., XI, pp. 180—82.

Mussel

English Investigations

Mussels

A large colony of mussels infected by *Mytilicola* has been found at Lowestoft and a single parasite was discovered at Great Yarmouth. This northward extension of the range had been anticipated. Further spread of the parasite will be studied.

Trials of the French "bouchot" system of mussel culture have proved successful. Growth of mussels has been better and level of infection with *Mytilicola* less than on adjacent natural beds. Steps are being taken to introduce the system to mussel fishermen.

Investigations of optimum conditions for growth of mussels showed that those transplanted from the tops of banks to low water ordinary springtide and low water extreme springtides increased their volume by 30 and 40% respectively compared with an increase of 11.8% of the controls during the period May to October.

A new type of dredge, developed at Conway, will lift mussels from deep water at the rate of 4 cwt. per hour.

Cockles

Investigations showed that texture of ground has little effect on growth but cockles in sheltered estuaries, particularly on the south coast, are bigger than those from elsewhere. Growth is best at low water extreme springtide though major settlement occurs between low water of neap tides and mean tide level. Growth-rate is unaffected by density of population until this exceeds 1,000 one-year-old cockles per m^2.

In Morecambe Bay a cockle mortality of 21.9% was directly attributable to oyster catchers (*Haemotopus*) during the winter of 1954-55. Total mortality was 73.8%. Severe damage to mussel beds has also been reported from several localities and a study of the rate of feeding on mussels is in progress.

Escallops

Gonad development was poor on the English Channel beds in spring but improved slightly later. Development of the new sledge dredge is continuing. Though dredging gave little indication of young scallops on the Port Erin beds, diving investigations have confirmed their presence.

H. A. COLE

The Quality of Marketable Mussels from the Dutch Waddensea in 1955

To increase our knowledge of biological productivity in the western part of the Waddensea, so necessary for our rapidly expanding mussel industry in these waters, we decided to continue our observations on the quality of marketable mussels grown there.

Unfortunately the year 1955 became a rather difficult one for the mussel industry in the western part of the Waddensea due to lack of sufficient quantities of mussel seed. Importation of mussel seed from other areas was not permissible owing to the danger of introducing the parasite *Mytilicola intestinalis*. Therefore the mussel farmers could only plant on their beds whatever mussels they could find on the local natural beds in shallow waters. As the best and youngest mussels from the natural beds were used in previous seasons, and as the settling of seed had been a failure in 1954, the only mussels available were rather old, of irregular size, and with thick, often eroded, shells. Such old mussels from shallow grounds, exposed for many hours a day, are usually in a poor condition, and are certainly not a choice quality for planting on the beds in deeper water. Half a loaf being better than no bread, fair quantities of these old and stunted mussels, interspersed with empty shells and other debris have been planted on the Waddensea beds early in 1955.

Figure 5

As this practice is abnormal, I considered the question of skipping the year 1955 for quality measurements in the Waddensea mussels and to resume this work in a year when the usual young mussels could again be used to stock the beds. It turned out, however, much to the surprise of the mussel farmers, that the poor mussels planted in 1955 developed nearly everywhere to marketable mussels of good quality, indeed frequently of excellent quality. Feeding conditions have apparently been so favourable that they more than made up for the poor quality of the mussels planted. As this information might be of scientific value in future, I finally decided to continue to measure quality indices of samples of mussels grown in the Waddensea and marketed late in 1955. The data thus obtained have been charted in Figure 5. A comparison with the data for 1954 (Ann. Biol., XI, p. 183, Fig. 4) shows that the quality of marketable mussels has been improved in 1955. Again the

figures from the beds south of the Isle of Terchelling are very high. In 1954 we found rather poor mussels on the south-westernmost plots (Nos. 6, 7, 180, 188, 201) which might have been caused by excessive sluicing of surplus fresh water from the IJsselmeer through the sluices at Den Oever. The mussel farmers noted that the quality of their mussels fell rapidly after continued sluicing of fresh water in the wet summer of 1954. The beds somewhat further east evidently escaped this danger. In 1955 the quality of the mussels was again excellent on the south-westernmost beds (Nos. 4, 5, 6, 179). There has been no surplus of fresh water in the summer of 1955. This indicates that the poor quality in this area in 1954 may indeed have been caused by a reduced salinity, and not by factors as increased silting, which would have been apparent also in 1955. The fact that the plots somewhat further east produced rather poor mussel in 1955 is hardly significant when considering the poor and irregular quality of the mussels planted there. It would be advisable, however, to pay special attention to this area in the future and to study the result of what happens when huge volumes of fresh water are sluiced at Den Oever.

The setting of mussel seed having been satisfactory in the summer of 1955, it may be expected that normal farming conditions will return on the Waddensea beds in the coming seasons.

P. KORRINGA

Epidemiological Observations on the Mussel Parasite *Mytilicola intestinalis* STEUER, undertaken in the Netherlands in 1955

Waddensea

Statistical data reveal a serious decline in the quantities of marketable mussels produced in the Waddensea. It yielded 44,500,000 kg. in the 1954—55 season, while only about 23,600,000 kg. was delivered in 1955—56. This does not mean, however, that biological conditions such as food, predators, and parasites, or hydrographical conditions as gales and ice prevented the mussel farmers from reaching high production figures. The insufficiency of young mussels on the natural beds in the Waddensea is mainly responsible for this noteworthy decline. Considering the great average age and the poor quality of the mussels planted early in 1955, it is still noteworthy that nearly 24 million kg. marketable mussels have been produced.

Mytilicola intestinalis has not been observed in the western Waddensea. The decreasing occurrence of this parasite in the transition area south of the Isle of Schiermonnikoog (KORRINGA, 1955), and the fact that there is no self-supporting population in the vicinity, caused us to advise some mussel farmers to plant locally collected mussels from natural beds on the deeper plots called Schildknoopen south of Schiermonnikoog, provided all transplantation could be carried out in the direction west-east. Inspection of several samples of these mussels late in October 1955 failed to reveal the presence of *Mytilicola*. It seems therefore possible to continue the exploitation of the beds south of Schiermonnikoog, provided that the area is kept under supervision, so that *Mytilicola* will have no chance of building up a numerous population.

Zealand

The very low level of the *Mytilicola* population in the Zealand waters late in 1954 (KORRINGA, 1955) improved the prospects for 1955. The total population of young mussels being moreover reduced in Zealand, the mussel farmers obtained permission, in the spring of 1955, to relay fair quantities of half-grown mussels from the natural beds in the eastern part of the Waddensea. These mussels showed only a very slight infection with *Mytilicola*. The total quantity planted, consisting of rather large, half-grown mussels, amounted to some 13,200,000 kg. Advice was given to the mussel farmers to avoid too great accumulation in particular waters and to concentrate on the shallower grounds, just below low water level, in order to prevent dangerous outbreaks of *Mytilicola*.

The growth and fattening of these mussels left little to be desired and most of them were marketable in late summer. In the 1955—56 season some 24,700,000 kg. have been landed from the Zealand streams. This is more than 51% of the total quantity of marketable mussels grown in Dutch waters in 1955—56! This excellent result may be ascribed to the modest action of *Mytilicola*. Above all, its initial population level was very low indeed early in 1955 (an unusually low number per mussel and a very reduced population of mussels infested with the parasite). Next, water temperatures were low in the first part of 1955 (Table 4) which retarded the development and spreading of *Mytilicola*. Further, the mussel farmers had indeed selected the shallower grounds and had chosen plots in a variety of districts where to plant the half-grown mussels from the Waddensea. Moreover, the good growth and fattening of the mussels permitted an early sale, so that many mussels avoided serious infestation with *Mytilicola* later in the year.

Table 2. Average Number of *Mytilicola* per Mussel

Zandkreek 91–92		Hammen 53		Grevelingen 170	
20. VII	0.0	23. VIII	1.2	18. VIII	0.5
25. VII	0.1	26. VIII	1.8	25. VIII	0.6
18. VIII	0.6	30. VIII	2.5	29. VIII	2.2
26. VIII	1.4				
30. VIII	2.4				
O.S.W.D. 104		O.S.W.D. 55		O.S.W.D. 86	
19. VIII	0.8	25. VIII	1.0	8. VIII	0.2
29. VIII	1.8	31. VIII	2.8	29. VIII	2.5

High water temperatures in August and September, however, led to a rapid numerical increase of *Mytilicola*. Repeated sampling from marketable mussels on plots in various districts speaks for itself (see Table 2).

In September it became clear that in one district, viz., the area near Ouddorp in the western part of the Grevelingen, the level of infestation became so high, that the mussels began to suffer. Soon they showed loss of byssus attachment, decline of condition, yellow coloured digestive glands, and lack of filling of the intestinal track, finally followed by a serious mortality. In short, exactly the symptom which formerly was observed in mussels heavily infested by *Mytilicola intestinalis*. Most of the mussels could be marketed, however, before loss of condition made sale impossible. Samples taken later in the season showed that *Mytilicola* infestation reached a really dangerous level in the Ouddorp region only, and there only it was necessary to leave fairly large quantities of mussels on the beds until the next season.

Table 4. Water Temperature in the Oosterschelde, 1955

Month	1955 Basin	1955 Western district	Average 1921—1939 Basin
January	1.7	3.4	3.0
February	2.4	3.2	2.9
March	2.3	2.7	4.9
April	8.3	8.1	8.5
May	11.8	11.9	13.3
June	15.7	15.2	16.9
July	19.1	18.5	19.0
August	19.7	19.5	18.8
September	17.9	18.0	16.6
October	12.9	13.8	12.1
November	8.2	9.9	7.1
December	5.8	7.0	3.6

Table 3. Average Number of *Mytilicola* per Mussel

Ouddorp area:	Date	Males	Females	Juveniles
Ouddorp 112 ...	22. IX	4.8	4.0	0.0
Ouddorp 115 ...	31. X	4.7	5.7	0.7
	22. XI	6.7	6.1	0.3
Ouddorp 121 ...	31. X	8.4	8.0	0.2
Central part Grevelingen:				
Grevelingen 78..	31. X	2.7	3.8	0.3
	22. XI	4.9	5.4	1.1
Grevelingen 178	22. XI	3.0	4.6	0.3
Grevelingen 134	22. XI	1.3	2.7	0.3
Dijkwater 168 ..	31. X	1.0	0.8	0.0
Eastern part Grevelingen:				
Herkingen 29 ..	31. X	2.7	3.5	0.1
Oude Tongsche Bank 41	22. XI	2.5	3.2	0.2

In districts other than the Ouddorp region there is hardly left any appreciable quantity of large mussels.

This all demonstrates that it is good policy to reduce the *Mytilicola* population as much as possible before the end of winter, so that the parasite population cannot reach a high level in the next summer. If practicable, there should only be planted half-grown mussels in *Mytilicola*-infested areas in order to minimize the risks as much as possible. It was known, however, that the supply of half-grown mussels was very limited on the natural beds in the eastern part of the Waddensea, late in 1955. To avoid a vacuum in the Zealand mussel district, the mussel farmers bought some $1^1/_2$ million kg. of small mussel seed collected from the breakwaters of the Belgian coast and this was planted between October 1955 and April 1956 on shallow mussel grounds in Zealand. Most of it was planted so late, however, that it remained completely free of *Mytilicola*, at least until May 1956. After having attained the size of a half-grown mussel this seed will be transferred to somewhat deeper beds in Zealand streams to grow to marketable quality.

P. KORRINGA

References.

KORRINGA, P., 1953, 1954, 1955. See Ann. Biol., IX, pp. 219—224; X, pp. 197—200, and XI, pp. 184—186.

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